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FACTORS THAT INFLUENCE BREAST CANCER DIAGNOSES IN VIRGINIA WOMEN 40-64 YEARS OLD WHO UTLIZED THE EVERY WOMAN'S LIFE PROGRAM 1998-2012

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FACTORS THAT INFLUENCE BREAST CANCER DIAGNOSES IN VIRGINIA WOMEN 40-64 YEARS OLD WHO UTLIZED THE *EVERY WOMAN'S LIFE* PROGRAM 1998-2012

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Abbreviations

ACA-Patient Protection and Affordable Care Act

ACS-American Cancer Society

BCCPTA-Breast and Cervical Cancer Prevention and Treatment Act of 2000

BRFSS-Behavior Risk Factor Surveillance System

CDC-Centers for Disease Control and Prevention

EWL-Every Women's Life

FPL-Federal Poverty Level

HP 2020-Healthy People 2020

NBCCEDP-National Breast and Cervical Cancer Early Detection Program

NCI-National Cancer Institute

NHIS-National Health Information Survey

USPSTF-United States Preventive Services Task Force

ABSTRACT

FACTORS THAT INFLUENCE BREAST CANCER DIAGNOSES IN VIRGINIA WOMEN 40-64 YEARS OLD WHO UTLIZED THE *EVERY WOMAN'S LIFE* PROGRAM 1998-2012

By Melanie Croft Dempsey, Ph.D.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

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This dissertation examines sociodemographic determinants and preventive health behaviors among women 40-64 years of age who participated in the Virginia Department of Health's *Every Woman's Life* breast cancer screening program. Utilizing secondary data, this research sought to explore patterns of breast cancer incidence, mammography screening utilization and sources of health information among low-income women.

The Virginia Department of Health provided a large sample size (N=34,942) on which to perform binary logistic regression analyses. Sociodemographic determinants and preventive health behaviors were analyzed as potential influencing factors in the diagnosis of breast cancer,

the stage at the time of diagnosis and source of health information. Additionally, frequencies across all variables were explored and compared to state and national statistics, where appropriate.

In this study, cancer and preventive health disparities reported in the literature persist within this sample of low income women. The binary regression analyses demonstrated that there are marginally worse outcomes for each level of decreasing income. Those with the most "wealth" were less likely to be diagnosed with invasive breast cancer and were more likely to obtain health information from a health provider. Additionally, it was determined that those without a prior mammogram were more likely to be diagnosed with breast cancer and the cancer was more likely to be invasive.

The aims of the *Every Woman's Life* program align with Affordable Care Act (2010) to strengthen health care and eliminate cancer disparities. Highlighting program characteristics and presenting these analyses allows policymakers, program officials and practitioners an opportunity to tailor health promotion activities while considering all tiers of influence.

CHAPTER 1

INTRODUCTION

According to the American Cancer Society [ACS] (2015), breast cancer is the most commonly diagnosed cancer in American women, excluding cancers of the skin. Breast cancer is the second leading cause of cancer deaths in the United States (US) among women, second only to lung cancer. For American women, there is an estimated one in eight (12%) lifetime risk of developing invasive breast cancer during their lifetime (ACS, 2015). This translates into more than 232,000 new cases of breast cancer in the US annually with an estimated 6,170 diagnosed among Virginia women.

While white women have the highest incidence rates of breast cancer, several disparities occur in comparison to other populations of US women. For example, among Hispanic women breast cancer is not only the most commonly diagnosed cancer, but it is the leading cause of cancer death in this ethnic group (ACS, 2015). Furthermore, African American women have the highest mortality rates from breast cancer and are 40% more likely to die from their disease than their white counterparts (Centers for Disease Control and Prevention [CDC], 2010). These disparities in survival are partially attributed to structural and personal barriers in cancer screening, such as access to mammography for the detection and diagnosis of breast cancer. The CDC cites variations in screening, follow-up and treatment patterns between white and African American women accounting for the differences in breast cancer death rates (CDC, 2009). The Institute of Medicine’s (IOM) landmark publication, *Unequal Treatment: Confronting Racial and Ethnic Dispartities in Healthcare* (2003), cites compelling evidence of racial and ethnic disparities in health outcomes, including breast cancer (Smedley, Stith & Nelson, 2003). Health disparity is a term used primarily in the US and may be used interchangeably with the more universal term “health inequity” (Braveman, 2006).

The Agency for Healthcare Research and Quality’s (AHRQ) 2009 National Healthcare Disparities Report central findings are that health disparities are common, insurance status is an important factor, many disparities are not decreasing, and cancer disparities warrant special attention (AHRQ, 2009). Consistent throughout the literature is the concept that access to cancer screening services is essential in reducing cancer health disparities.

In response to the breast cancer epidemic and evidence of disparities in access to care, appropriate treatment and survival, the federal government passed Public Law 101-354, the Breast and Cervical Cancer Mortality Prevention Act of 1990 (CDC, 2013). This law established the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), which is executed and administered by the CDC with the purpose of providing screening examinations for underserved women. Over the years, the quality of the program has been evaluated through independent analysis and research. Benard, Saraiya, Soman, Roland, Yabroff & Miller (2011) concluded that the beliefs and screening practices among participating physicians were similar to non-program providers suggesting adherence to one standard of care. Additionally, women screened by the program were found to receive treatment within the prescribed 60-day from diagnosis benchmark (Richardson, Royalty, Howe, Helsel, Kammerer & Benard, 2010). Researchers at the Research Triangle Institute International analyzed data that suggest the NBCCEDP breast cancer screening program reduced mortality among participants (Hoerger, Ekwueme, Miller, Uzanangelov, Hall, Segel et al., 2010). The NBCCEDP operates in all fifty states, with Virginia's program executed through the Virginia Department of Health's "*Every Woman's Life*" (EWL) program.

Paralleling the NBCCEDP, Healthy People 2020, a comprehensive framework developed by multiple federal agencies, stakeholders and advisory committee, also emphasizes breast cancer as part of its overall focus. Three main goals of Healthy People 2020 are to 1) achieve health equity, 2) eliminate health disparities and 3) improve the health of all groups. The Healthy People 2020 Objective C-17 established a goal to increase the proportion of women who receive a breast cancer screening by 10%, thereby, acknowledging the importance of mammography in the early detection of breast cancer (U.S. Department of Health and Human Services [HHS], 2013).

More recently, the Patient Protection and Affordable Care Act (ACA) was signed into law in March, 2010 (Patient Protection and Affordable Care Act, 2010). Title IV of the law addresses prevention of chronic disease and improvement of public health which includes a national prevention and health promotion strategy. It is expected that many preventive care services, including mammography, will be 100% covered under this new law (IOM, 2011). Unless otherwise specified, a mammogram in this text will represent a screening mammogram, which is a series of –rays to visualize breast tissue used to detect and diagnose breast cancer. This is in contrast to a "diagnostic" mammogram, a term reserved for special views obtained after a lump or another sign of disease is found.

Although two of the leading authorities on cancer screening, diagnosis and treatment may differ on issues such as the age for initial, baseline mammography screening, both agree on the imperative for screening to improve morbidity and mortality outcomes. The American Cancer Society (ACS) revised breast cancer screening guidelines in 2015 to include yearly mammograms beginning at age 45. ACS is commonly recognized as a leading authority on cancer care for both health professionals as well as the lay population (ACS, 2015). The United States Preventive Services Task Force (USPSTF), another leading authority in disease prevention and evidence-based medicine, recommends biennial screening for women 50 to 74 years of age. The USPSTF is comprised of a panel of independent experts that review evidence-based findings and make recommendations on preventive health care services for primary care physicians and health systems through AHRQ. Martin and Wingfield (2012) called for a change in the USPSTF 2009 guidelines to account for underserved populations, such as African American women, with low screening rates, advanced tumor stage at the time of diagnosis and higher mortality from breast cancer. These inconsistencies in screening recommendations may confuse the public and may serve as a deterrent to screening. In September 2013, published findings indicated the highest breast cancer mortality occurs among those not regularly screened (Webb, Cady, Michaelson, Bush, Calvillo, Kopans, et al., 2013). The authors recommend regular annual, rather than biennial, breast cancer screening beginning before the age of 50.

Virginia's *Every Woman's Life* (EWL) program uses federal funds allocated by the CDC as part of the NBCCEDP to provide free mammograms and diagnostic services to low income female residents of Virginia ages 40-64 (Virginia Department of Health [VDH], 2013). Program eligibility criteria require that participants have limited or no insurance with an income at or below two times the established Federal Poverty Level (FPL). Though approximately 75,000 Virginia women are eligible based on census data, funding allows approximately 7,500 (10%) of those eligible to receive the benefits of the program (EWL Program Fact Sheet, 2014). The EWL program adheres to the USPSTF 2002 screening guidelines, which are closely aligned with previous American Cancer Society (ACS) guidelines which recommended annual screening mammograms beginning at age 40. The EWL program is a collaborative effort with 32 enrollment sites across the Commonwealth of Virginia utilizing more than 250 clinical service - providers.

Rationale for the Study

Despite efforts to eliminate health disparities, they persist chiefly among low-income ethnic and racial minorities (Smedley et al., 2003). This investigation explores sociodemographic factors that may be associated with breast cancer diagnoses in Virginia women 40-64 years of age who utilize the *Every Woman's Life* program. Sociodemographic variables (age, race, education, income, insurance status, language) are widely reported in health promotion and public health literature. Given that one of the eligibility requirements to receive free mammograms through the EWL program includes an income at or below 200% FPL, this provides a unique opportunity to analyze data with socioeconomic status (SES) held to a prescribed threshold, all of which would be classified as "low income." This research explores breast cancer diagnosis, stage at the time of diagnosis, and preventive health behaviors within this subset of Virginia women. Findings may identify trends and opportunities to recruit from priority populations who are currently underserved.

The United States has an increasingly diverse population with recent census data projecting that by 2050, there will be no clear racial or ethnic majority. This change in the sociocultural composition of the US has wide-ranging implications, to include health and health care. Virginia has a very diverse population with one in ten residents foreign born, 40% from Asia and 36% from Latin America (Cardenas, Ajinkya & Leger, 2011).To illustrate, Virginia has 25 counties in "Appalachia," a designated area with regions characterized by depressed economics, high unemployment, poor health and educational disparities while northern Virginia, for instance, enjoys considerable financial affluence and high educational attainment (Appalachian Regional Commission, 2013). According to the US Census (2014), Virginia's racial demographics closely mirrors population demographics of the entire US with 70.5% reporting their race as White (US, 77.4%), 19.7% Black or African American (US, 13.2%), 0.5% American Indian and Alaskan Native (US, 1.2%), 6.3% Asian (US, 5.4%) and 0.1% Native Hawaiian and Other Pacific Islander (US, 0.2%). Additionally, 14.9% of Virginian's surveyed report a language other than English spoken at home while 20.7% was reported across the US (US Census, 2014).

Population-based surveillance data are used extensively in cancer-related literature. Census, vital statistics and national health surveillance tools are used to assess health attitudes, behaviors and knowledge. While these tools provide valuable data, each have limitations and do not provide detailed information on a state or regional level. For example, the Behavioral Risk Factor Surveillance System (BRFSS), established in 1984 by the CDC, is a state-based random-digit-dialed telephone survey, expanded in 2011 to include cell phone numbers (CDC, BRFSS History, 2013). Conducting over 400,000 interviews annually, the BRFSS is the largest telephone survey providing information about health risk behaviors, chronic health conditions and use of prevention services among US residents. Often cited in breast cancer screening literature are mammographic screening rates derived from BRFSS survey data. The 2010 BRFSS found 77.7% of Virginia women ≥40 years of age self-reported having a mammogram in the past two years as compared to 75.4%, the national average.

Statistics, available on both government and non-governmental organization websites such as the American Cancer Society's website, www.cancer.org, are primarily reported from the Surveillance, Epidemiology and End Results program (SEER) data. SEER is the only national program that provides stage of disease at the time of diagnosis along with survival data. It is a program in the division of the Cancer Control and Population Sciences at the National Cancer Institute (National Cancer Institute [NCI], 2015). Additionally, the National Cancer Data Base (NCDB) is a joint effort of ACS and the Commission on Cancer. Begun in 1989, the NCDB is an outcomes database which compiles cancer registry data and captures more than 75% of all new cancer diagnoses in US. These data are tracked and analyzed, revealing important trends in cancer incidence and treatment. In addition, the EWL Cancer Statistics and Tracking (CaST) database is routinely synchronized with the Virginia Cancer Registry. Part of the information exchanged via an electronic interface includes American Joint Commission on Cancer (AJCC) staging information, which is considered essential information to cancer care professionals. In this study, AJCC staging is used to operationalize “early” and “not early” breast cancers.

Plescia & White (2013) report gaps in screening among the low-income women, uninsured and women without a usual source of care. These same authors found nonfinancial factors that may influence a woman’s ability to assess screening services which include language, geography, cultural differences, provider biases, lack of social support and lack of knowledge. There is a large volume of literature dedicated to identifying barriers to preventive health behaviors, particularly cancer screenings. Though it is important to identify barriers and recognize gaps in mammographic screening, women utilizing EWL services are assumed to have overcome barriers in that they successfully secured a mammogram.

Statement of Purpose

With the primary aim of this study being to identify factors are associated with a breast cancer diagnosis among the low-income population utilizing EWL services in Virginia, it is necessary to evaluate and report data beyond the current scope of EWL reporting. The CDC requires specific quality measures and statistics from states receiving NBCCEDP funding. However, reports generated by the CDC are limited to women served, women screened, and women receiving mammography, the percentage of abnormal mammograms, and total number of cancers diagnosed. Therefore, the aggregated data offers little insight into the differences among and within groups utilizing EWL mammography services. Beyond addressing the statistical analyses, this research study will consider both practice and policy implications for the EWL program based on the findings.

Sociodemographic (age, race, education, language, geographic locale and income) differences between those diagnosed and those not diagnosed with breast cancer, including stage at the time of diagnosis, were analyzed. Preventive health behaviors such as having a prior mammogram and smoking cessation intent was used to further examine stage at the time of diagnosis in this sample of women. Additionally, sources of information to access the program were explored by the same sociodemographic variables as previously delineated. The EWL mammography screening program provides detailed participant demographic and cancer data which permit these analyses. Research using this type of individual level data is limited in the literature. More commonly in health promotion and public health research, large scale population surveys serve as the source of data.

To date, there is no published literature exploring data from Virginia's *Every Woman's Life* program outside of volume statistics reported on the CDC and Virginia Department of Health (VDH) websites. To provide a frame of reference for this study, an overview of breast cancer literature including risks, screening, cancer incidence and mortality, pertinent legislation as well an introduction to the socioecological model follows.

Overview of the literature

Breast cancer is the most commonly diagnosed cancer among US women (NCI, 2014). As such, it has been the topic of much research investigating the disease itself, incidence and mortality rates, risk factors, and barriers to both screening and treatment. It bears repeating that the American Cancer Society estimates one in eight women in the US to develop breast cancer in their lifetime (ACS, 2015). Cancer statistics are compiled and published through the NCI's Surveillance, Epidemiology and End Results Program (SEER) recognized as a premier, trusted source. Risk factors that are modifiable, such as diet, smoking status and exercise, are of particular interest in preventive health research. Preventive health behaviors and their influence on disease incidence and severity of disease are abundant in the literature. Mammography, considered a preventive health behavior, is reported to reduce breast cancer mortality by 10-25% (Nelson,Tyne, Naik, Bougatsos, Chan & Humphrey, 2009). Early detection and appropriate treatment improves health outcomes, most often measured in decreased cancer mortality rates. Barriers to mammography include insurance, lack of physician recommendation, facility capacity and geographic isolation to name a few. In a study by Sabatino, Coates, Uhler, Breen, Tangka & Shaw (2008) the greatest difference in mammography use was among those with and without insurance.

Breast cancer incidence and mortality varies disproportionately across racial and ethnic groups-these disparities are explored in the literature. The compelling evidence of breast cancer screening and mortality disparities reported in the literature, along with a favorable political climate, led to the enactment of the National Breast and Cervical Cancer Mortality Prevention Act in 1990. While this program provided needed screening services to low-income women, there were no provisions for treatment of women diagnosed with cancer by utilizing these screening and diagnostic services. To alleviate this issue, the Breast and Cervical Cancer Prevention and Treatment Act of 2000 (BCCPTA) provided a mechanism to fund treatment for women diagnosed through the NBCCEDP through Medicaid expansion (Breast and Cervical Cancer Prevention and Treatment Act of 2000, 2000). The most recent legislation to impact breast cancer screening is the Patient Protection and Affordable Care Act (ACA) signed into law March 2010 by President Barack Obama (Patient Protection and Affordable Care Act, 2010). Though the law is not expected to be fully implemented until 2015, preventive care is a major provision of the law. As such, mammograms are expected to be covered across all insurance plans with the elimination of cost-sharing, where the consumer does not incur any out-of-pocket expenses for the service. Through the ACA, a National Prevention Council was established to guide and coordinate efforts across agencies to move the US toward a "prevention-oriented" society (National Prevention Council, 2010).

Theoretical Framework

With so many influences on a woman's decision and ability to participate in preventive health services, such as mammography, the socioecological model (SEM) is an appropriate framework with which to work. First used to describe preventive health interventions by McLeroy, Bibeau, Steckler and Glanz in 1988, the socioecological model accounts for individual, interpersonal, organizational, community and public policy influences. The social ecological model, depicted in figure 1.0, is a systems model utilized in health promotion, health disparities research and cancer prevention programs (Golden and Earp, 2012). In as much as health and health behaviors are not determined by any single factor, this interactive model can help frame the EWL breast cancer screening program at every level. The levels of influence identified in the social ecological model are individual, interpersonal, organizational, community and policy. While a more detailed and expanded presentation of the model appears in Chapter 2, it is important to recognize that each structural level may be simultaneously influenced by one or more of the other layers. A key concept of the ecological perspective is “reciprocal causation”, whereby individual health behaviors both impact and are impacted by their social environment (Rimer & Glanz, 1997). For instance, a woman contemplating her first mammogram may seek information from a community health fair (community level), the local health department (organizational level) and a trusted friend or relative (interpersonal) before taking action to obtain the mammogram. Once empowered to obtain the mammogram, perhaps the woman encounters structural barriers such as access to a facility with suitable hours of operation to accommodate her work schedule. Through inquiry and petition the woman (individual level) is able to influence local health department (organizational level) to provide mobile mammography in her community thus inspiring her peers (interpersonal level) to obtain screening mammograms as well. This illustrates the bi-directional influences that impact the success or failure of a health promotion program or cancer screening program. The EWL program was not developed in isolation nor can it be successful without attention from all stakeholders at all levels, from consumers to lawmakers.

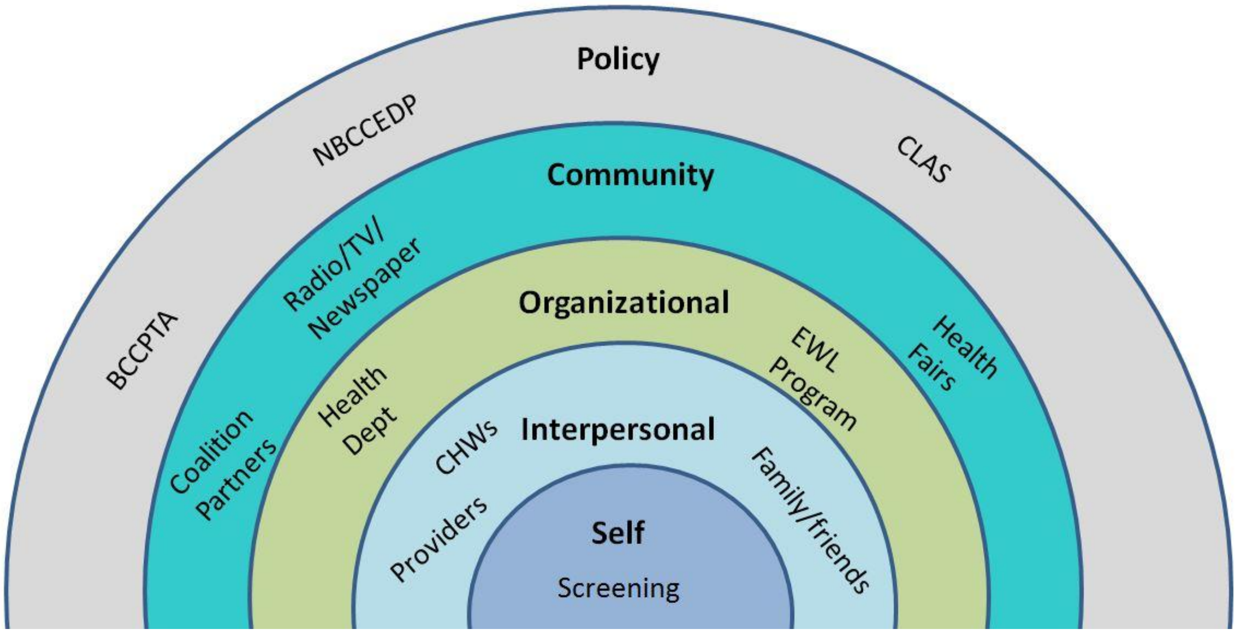


Figure 1.0 Socioecological model of the *Every Woman's Life* program

In order for eligible individuals to take advantage of free breast cancer screenings, there must be programmatic support at the organizational, community and public policy levels. Public policy, at the outermost level of influence, provides the framework and funding for the EWL program. Other policies, less directly involved but important to program success, would be federal, state and local policies which impact public transportation, impacting access to medical services. Also at the policy level, changes in screening and clinical guidelines determine an individual's eligibility for and access to the breast cancer screening program.

The next structural level of the socioecological model (community) provides breast cancer education and awareness, often serving as the impetus for action. Community health programs, media campaigns or employer/worksite initiatives are considered part of the community level of the influence. Organizational levels of influence would include the EWL program itself and its' community coalition partners and clinical service providers (hospitals, clinics, and health departments).

Individuals operate within their own interpersonal networks and may use this extended family as "sounding boards" for health decisions. Interpersonal levels of influence may include: 1) providers, 2) family, 3) community health workers, 4) friends and 5) patient navigators. Finally, the individual level of influence hinges on the concept of self-efficacy (Bandura, 1977) which plays a role in one's movement toward healthy choices. Biological and personal history factors such as race, age, education, income, primary language and geographic location influence an individual's likelihood of modifying or adopting a health behavior (Rimer & Glanz, 2005). Individuals must have adequate knowledge, favorable attitudes and beliefs that encourage preventive health behaviors, such as cancer screening and smoking cessation before definitive action is expected (Werle, 2011).

Maintenance and growth of programs, like the EWL program, have continued reliance on public policy, support from the community, organizational backing, acceptance and promotion among the medical and lay communities and finally, the courage of individuals to overcome personal barriers to screening.

Research Questions

This research provides a basis for understanding and evaluating various influences on breast cancer diagnoses among participants in Virginia's *Every Woman's Life* program. Data elements secured include demographics (age, race, language, county of residence), economic measures (levels of income and education), preventive health behaviors (prior mammogram, intent to quit smoking) and source of referral to the EWL program, along with cancer diagnostic and staging information. The socioecological perspective recognizes these individuals, as part of a social environment and the EWL network, thereby having multiple levels of influence which impact health outcomes, such as breast cancer. Within this framework and these data parameters, the overarching question is: What factors can be identified that may influence breast cancer diagnoses among low income women 40-64 years old? The following research questions are designed to answer the overarching question.

Research question one (RQ1). What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and prior mammography and cancer diagnosis among women 40-64 years of age utilizing *EWL* services?

Research question two (RQ2). What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and prior mammography and cancer stage at the time of diagnosis among women 40-64 years of age utilizing *EWL* services?

Research question three (RQ3). What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and source of information among women 40-64 years of age utilizing *EWL* services?

Design and Methods

This non-experimental study analyzed existing data from the *Every Woman's Life* database (CaST), comprised of all breast cancer screening participants in calendar years 1998 through 2012. The selected timeframe begins with the first full calendar year of the EWL program and concludes with the last year data synchronization with the Virginia Cancer Registry was initiated, intended to provide AJCC staging information for breast cancers diagnosed. These data were made available through the VDH, following Institutional Review Board (IRB) approval by both Virginia Commonwealth University (Appendix A) and the VDH (Appendix B), which required a data use agreement (Appendix C). This data set contains 34,942 participants and of these, 1143 had a breast cancer diagnosis. The sample was limited to women 40-64 years of age.

Detailed descriptive and inferential statistics are presented in Chapter 3. Logistic regression models were used to answer each of the research questions. Sociodemographic factors (age, race, income, language, geographic locale and education) were used as independent variables with dichotomous categorical dependent variables breast cancer diagnosis in RQ1 and breast cancer stage in RQ2. Trusted source of health information was the dependent variable in RQ3 with a calculated independent variable consisting of two preventive health behaviors, prior mammogram and smoking cessation intent.

Organization of Remaining Chapters

The remaining chapters present the existing literature on the subject, the methodology, the results and the discussion and conclusions. Chapter 2 presents an extensive review of previous research on the topic and an explanation of the appropriateness of the theoretical framework chosen to examine the topic. Chapter 3 elaborates on the study sample and outlines the research design and statistical methods used to conduct the analyses. The empirical results are detailed in Chapter 4. Lastly, Chapter 5 summarizes and discusses the study results, draws conclusions and offers recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

The underutilization of screening mammography for early breast cancer detection and the reduction of disparities in breast cancer morbidity and mortality in underserved women has been a focus of much research. In order to examine the extant literature related to the research questions in this study, an extensive review of the literature was conducted. This review describes several areas of prior research relevant to this study, including breast cancer and its' associated risk factors, mammographic screening access, guidelines and utilization, breast cancer disparities, preventive health behaviors and the impact of legislation and policy.

The literature review covers the period 1990-2015, a period marked by several significant breast cancer control milestones. Those milestones include key pieces of legislation, landmark publications, national healthcare initiatives and prevention programs as depicted in Appendix D. The literature review is organized and presented within eight interrelated topics following the "Method for the Review of the Literature:"

Breast Cancer Trends

Breast Cancer Risk Factors

Mammographic Screening and Guidelines

Mammographic Capacity and Access

Impact of Barriers on Mammographic Screening Rates

Breast Cancer Disparities

The Impact of National Legislation and Policy

National and State Breast Cancer Screening Programs

Preventive Health Behaviors

Trusted sources of health information

Theoretical Framework

Method for the Review of the Literature

Search criteria. The search parameters included studies published in peer-reviewed journals from 1990 to present. The year 1990 was used as a lower limit to coincide with the enactment of the Breast and Cervical Cancer Prevention and Mortality Act which spawned the NBCCEDP. Keywords, used in various combinations included: breast cancer, cancer disparities, mammography, cancer screening, barriers, NBCCEDP. An initial list of studies was created through searches of the following databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE/PubMed, Social Science Abstracts, Women's Studies International, Education Research Complete, Academic Search Complete and Health and Psychosocial Instruments. Publications produced by the National Academies Press, Institutes of Medicine (IOM) and other government agencies such as AHRQ were hand searched for important works. Additionally, references of primary sources were also hand searched. Internet websites of premier oncology and government agency websites were explored to obtain the most up-to-date information. Sources for research methods and statistical analysis, including textbooks and websites, were utilized to aid the researcher in conducting this review.

Selection criteria. All articles from the initial search were hand searched for titles and abstracts pertinent to the topic. Upon review, 150 were deemed relevant while 25 were removed from review. In total, 98 journal articles, 10 textbooks and 15 agency reports, manuals and factsheets were utilized in the final analysis, along with numerous statistical references.

Breast Cancer Trends

With the exception of skin cancer, breast cancer is the most commonly diagnosed cancer among women in the United States (National Cancer Institute [NCI], 2015). Breast cancer is second only to lung cancer in cancer deaths among US women (NCI, 2015). However, among Latino women, breast cancer is the leading cause of cancer mortality (American Cancer Society [ACS], 2015). The ACS reports a 12% (one in eight) lifetime risk of developing breast cancer for all women in the United States (ACS, 2015). Further, 2015 ACS statistics estimate 231,840 women will be diagnosed with breast cancer with 40,290 estimated deaths (ACS, 2015). While breast cancer does occur in men, it is 100 times more likely in women (NCI, 2015). As such, this discussion will be limited to breast cancer as it impacts women in the United States. The NCI and ACS are often cited as the source for cancer statistics, the premier primary source for United States (US) cancer incidence and survival statistics is the Surveillance, Epidemiology and End Results Program (SEER) of the NCI.

Breast cancer, as in all other types of cancer, is diagnosed at various stages. It is generally accepted that better outcomes result when cancers are diagnosed early. Simply stated, less advanced cancer is predictive of a better prognosis or disease-free interval (Soerjomatoram, Louwman, Ribot, Roukema, Willem & Coebergh, 2008). Figure 2.1 reflects the 2005-2011 five year relative survival data. Cancer stage at the time of diagnosis is also significant in determining the appropriate individual treatment regimen (NCI, 2015).

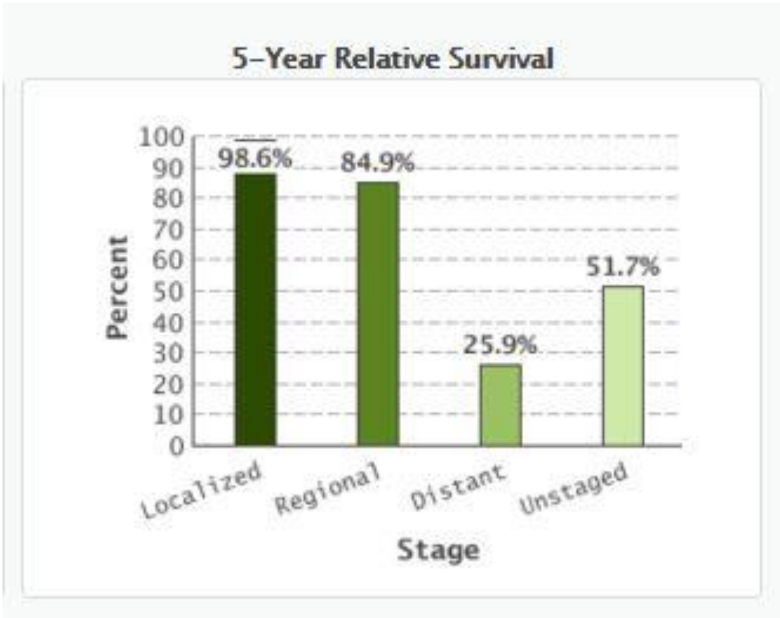


Figure 2.1 Breast Cancer 2005-2011, All Races, Females 5-Year Relative Survival by SEER Summary Stage
Source: SEER, 2015

Breast Cancer Risk Factors

A risk factor increases the probability of developing a disease. Risk factors for breast cancer can be divided into those which can be altered (modifiable) and those that cannot be altered (non-modifiable) by the individual. Increasing age is the strongest risk factor for breast cancer (NCI, 2015). Most recent data estimates a 1 in 68 (1.47%) risk of a woman developing breast cancer during her fourth decade of life, increasing to 1 in 42 (2.38%) when a woman reaches 50 years of age. Additional increases in risk are expected in the sixth and seventh decades of life (3.56%, 3.82%, respectively). Other risk factors which are non-modifiable include race, genetic predisposition, family or personal history of breast cancer, breast tissue density, early menarche, and previous radiation therapy. Modifiable risk factors may include obesity, alcohol use, and low levels of physical activity (ACS, 2015).

The incidence of new cases of breast cancer has been found to vary by race as depicted in Table 2.1 based on the most recent data (SEER, 2015). In the US, white women experience the highest breast cancer incidence with 127.9 new breast cancer cases per 100,000, while American Indian/Alaska Native (AI/AN) women have the lowest reported incidence at 82 new breast cancer cases per 100,000 per year. However, breast cancer screening and mortality (death) rates do not follow this same pattern. In other words, though white women have the highest incidence of breast cancer diagnoses they do not have the highest breast cancer mortality rates. At 30.2 breast cancer deaths per 100,000, African American women experience disproportionate mortality compared to white women (21.3 per 100,000) and all other racial and ethnic groups (SEER Stat Fact Sheet: Breast Cancer, 2015). These disparities in screening rates and breast cancer mortality across racial and ethnic groups are the focus of much cancer research.

Table 2.1

Breast cancer incidence and mortality by race/ethnicity

	New cases per 100,000	Number of Deaths per 100,000
All races	124.8	21.9
White	127.9	21.3
Black	124.4	30.2
Asian / Pacific Islander	96.3	11.4
American Indian / Alaskan Native	82.0	15.0
Hispanic	92.1	14.5
Non-Hispanic	130.1	22.6

U.S. 2008-2012, Age-Adjusted

Source: 2015 SEER Stat Fact Sheet

Mammographic Screening and Guidelines

Screening mammography is a series of x-rays of both breasts used to detect and diagnose cancer in women who exhibit no signs or symptoms (NCI, 2014). It is desirable to detect breast cancer at its’ earliest stages, before the disease spreads to other tissues. With early detection healthcare providers may initiate treatment sooner in the disease process, when treatment is most effective.

It has been widely accepted that benefits of mammography outweigh the risks associated with the low dose of radiation associated with its' delivery (NCI, 2014). In the literature, mammography accounts for 10-25% reduction in breast cancer mortality (Nelson et al., 2009). An IOM and National Research Council committee concluded that mammography is the best strategy to save women's lives (Joy, Penhoet & Petitii, 2005). Most recently, however, the benefits of mammography have been challenged in the literature and in the mainstream media. One Canadian randomized trial with 25 year follow-up data concluded annual mammography does not reduce breast cancer mortality differentially than routine physical examinations when adjuvant therapy for breast cancer is available (Miller, Wall, Baines, Sun, To & Narod, 2014). Pace and Keating (2014) reviewed decades of breast cancer screening literature and concluded that while mammography is associated with a reduction in breast cancer mortality, there is a high risk (61%) for a false-positive result for 40-50 year old women receiving annual mammograms. Ultimately, Pace and Keating (2014) recommended individualized screening decisions based on patients' individual risk factors and personal preferences. While individual screening guidelines and shared decision making are ideal, as acknowledged by Elmore and Kramer (2014), high-risk populations continue to need frequent breast cancer screenings.

The USPSTF breast cancer screening guidelines, revised in 2009, are no longer congruent with the ACS recommendations. According to the USPSTF, women aged 50 to 74 years of age should have screening mammography every two years. In contrast, the ACS recommends yearly mammograms beginning at age 45, with no endpoint (Oeffinger, 2015). This inconsistency may add confusion or suspicion among women, particularly among underserved or marginalized populations. This, in turn, may trigger delays in obtaining appropriate screening mammograms or preclude them from screening altogether. Martin and Wingfield (2012) highlight the potential negative impact on the African American community by the revised USPSTF screening guidelines which recommend biennial screening for women aged 50-74. Interestingly, the impact of the very recent ACS revisions to their guidelines remain to be studied.

Healthy People 2020, a nation-wide initiative focused on improving the health of Americans, established an objective (C-17) to increase the proportion of women who receive a screening mammogram according to the most recent USPSTF guidelines to a target level of 81.1% since breast cancer continues to be a prominent health issue in the United States (USHHS, 2013). These guidelines have come under scrutiny following the publication of a recent *Cancer* journal article citing most breast cancer deaths occur in women not regularly screened (Webb et al., 2013). If confusion exists among health care professionals as to the appropriate age for and frequency of breast cancer screening, this only adds to the list of barriers to screening for women in the U.S.

Mammographic Capacity and Access

Access to mammography is consistently reported in the literature as a barrier to screening. More specifically, access may be complicated by insurance status, transportation, or simply the lack of a facility nearby. The United States Government Accountability Office (GAO) reported the mammography capacity across the US is adequate, but noted limited access in certain locations (GAO, 2006). The number of mammography facilities decreased from 2001 to 2004. The loss or absence of mammographic units in some areas result in longer wait times or an increase in distance traveled to obtain services, negatively impacting those residents. These access problems may particularly impede uninsured and low-income women who already have lower than average utilization of mammographic services (GAO, 2006).

In 2012, researchers examined the relationship between mammography capacity and population characteristics at the county level (Peipins, Miller, Richards, Bobo, Liu, White et al., 2012). Twenty-seven percent (n=870) of counties in the United States have no mammography facilities. These counties typically have low population density, low numbers of primary care physicians and low percentage of insured residents. Elkin, Atoria, Leoce, Bach & Schrag (2013) assessed changes from 2000 to 2010 in the availability of screening mammography in the US. Findings reported by Elkin et al. (2013) reinforced breast cancer disparities identified in counties with no or limited mammography capacity. Cross sectional analysis revealed counties with more uninsured residents, less educated residents, greater population density and a higher percentage of managed care had lower mammography capacity.

Impact of Barriers on Mammographic Screening Rates

Using National Health Interview Survey data, Sabatino et al. (2008) reported the greatest disparity in mammography use among the uninsured when compared to women with insurance. Consistent in the literature, income was reported to be a barrier to screening with low mammography use among low-income women and the highest use among women with high incomes. Sabatino et al. (2008) found no disparity in mammography use among African Americans compared to white women, but Asian women had the lowest self-reported mammography use among all racial groups represented in the survey. The authors acknowledged a small sample size may have impacted the reliability of some estimates in this group of women. A CDC report using BRFSS data also found the lowest screening rates among women with household incomes less than $15,000 and without insurance. In contrast to Sabatino et al. (2008), the CDC report indicated the lowest mammography screening rates among American Indian/Alaska Natives.

In a survey study of women (n=1,242) in central Texas, researchers reported the relationship of screening rates with demographic, health status and health care access factors (Smith, Hochhalter, Ahn, Wernicke & Ory, 2011). No racial or ethnic minority disparity in screening mammography was found. Ninety-three percent of respondents reported having a mammogram during their lifetime with 76.2% having a mammogram in the past two years. Those without a routine mammogram in past two years reported a lapse in insurance or live in a health care provider shortage area, both of which represent a problem with access to health care.

In a cross-sectional study (n=178) of low income African American women, Young, Schwartz and Booza (2011) conducted interviews in a high cancer mortality area of Detroit, Michigan. The authors defined structural barriers as the lack of insurance, provider and/or facility. Clinical barriers included communication and education. The third barrier, personal, analyzed in this study included knowledge and lack of trust. Most commonly identified structural barriers among participants included long wait times for mammography services (29%), mammography not covered by insurance (18%), no facility in area (18%), no transportation (16%) and cost (15%). In addition, poor communication and education were recognized as clinical barriers to mammography use. Incorrect knowledge of cancer risk factors, effectiveness of screening mammography and fear of surgery were among the highest ranked personal barriers. In their analysis, statistically significant structural barriers were the lack of health insurance and lack of a regular health care provider or facility. Personal and structural barriers may not be impacted by healthcare providers, but clinical barriers, such as education and recommendation for mammography, are within their scope or range of influence.

Statistics continue to indicate eligible women are not screened at recommended levels or frequencies (Mortality and Morbidity Weekly Report, 2010). Using BRFSS data, the CDC reported a 81.1% overall screening rate among 50-74 year old women in the United States. According to that report, American Indian/Alaska Native women had the lowest screening rate at 70.4%. Socio-demographic factors appear to impact screening rates. Uninsured women were screened at 56.3% as compared to 83.8% of insured women. Low income, defined as less than $15,000 annual income, negatively impacted breast cancer screening rates among US women with only 69.4% reporting mammography screening in the past two years. Level of education was correlated with screening rates with the lowest screening rate among those not finishing high school. Similarly, Young, Schwartz and Booza (2011) reported lack of knowledge and subsequent fear were deterrents to low income, medically underserved African American women obtaining mammograms. Other ethnic and racial minority groups, such as Thai, American Indian/Alaska Native and African Americans studied in the literature report education, literacy, knowledge and fear as personal barriers to screening (Daley et al., 2012).

In a systematic review of the literature, Schueler, Chu and Smith-Bindman (2008) reported lack of physician recommendation as a primary reason for not having a mammogram. This is consistent with other breast cancer screening literature including a survey conducted by Smith et al. (2011) among middle-aged and older women in central Texas. Nuno, Castle, Harris, Estrada, and Garcia (2011), in a cross-sectional study of 504 Arizona residents, also concluded clinician recommendation may improve screening rates among Hispanic women living near the US-Mexico border.

Smith et al. (2011), with data obtained from a random sample of mailed surveys, found low screening rates among participants living in a health care provider shortage area. Through evaluation of NHIS data, Sabatino et al. (2008) also recognized those without a usual source of care or medical home reported lower mammography use. Principles of a patient-centered medical home are explored by Ferrante, Balasubramanian, Hudson and Crabtree (2010) using hierarchical linear modeling with survey and chart audit data from 24 primary care offices. They found a high correlation between preventive services and participation in a patient-centered medical home. Promoting cancer screening is one core element of the newly designated patient centered medical home (Sarfaty, Wender & Smith, 2011).

Daley, Filippi, James, Weir, Braiuca, Kaur et al.(2012) conducted a qualitative study to assess needs and barriers to mammography among American Indians in Kansas. The researchers conducted interviews with community leaders (n=13) as well as providers (n=17). Barriers identified by community leaders included fear, access and embarrassment. Among providers, barriers identified were education and access to services. These barriers are consistent with difficulties across the US when promoting breast cancer screening in diverse populations. The primary findings included participants' request for culturally-appropriate information/education, health literacy promotion and patient navigators.

American Indians/Alaskan Natives report low screening rates while breast cancer incidence is on the rise and mortality is higher than their white counterparts (Daley et al., 2012). Screening prevalence, as depicted in Figure 2.2, varies across racial and ethnic groups. Screening adherence impacts the stage at which breast cancer is detected which may impact treatment and ultimately, survival or conversely, mortality. Disparities in breast cancer mortality exist among low-income, racial and ethnic groups which means survival varies by more than incidence. Research continues to explore factors that may explain these disparities.

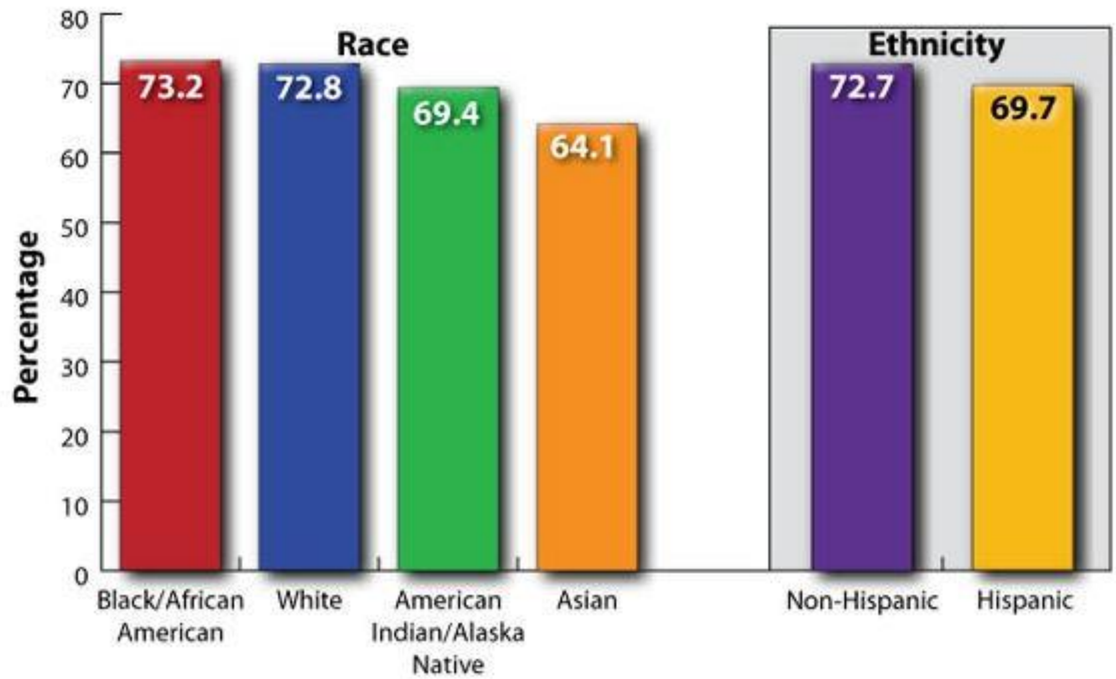


Figure 2.2 , Mammographic screening rates by race/ethnicity
Source: CDC, 2010

Breast Cancer Disparities

As previously discussed, breast cancer screening and survival rates do not follow the racial and ethnic incidence rates of breast cancer in the United States. That is, racial groups with the highest breast cancer incidence do not have the highest breast cancer mortality rates. Breast cancer disparities are widely explored in the literature. Certain factors associated with breast cancer that saturate the literature that will be addressed here include: age, race, ethnicity, language, geographic locale, education, socioeconomic status (SES) and insurance status. Others, beyond the scope of this study, include disabilities, obesity, biologic indicators, travel time or access to mammographic facilities and cultural beliefs. An emerging body of evidence suggests disparities in breast cancer mortality among racial and ethnic minority groups may be greatly influenced by tumor biology (Krieger, 2013).

A 2012 CDC report used United States Cancer Statistics data to calculate racial disparities in breast cancer severity (MMWR, 2012). African American women, despite lower incidence rates, had a 41% higher mortality rate from breast cancer. Additionally, African American women were diagnosed at later stage compared to white women (45% versus 35%) and experienced more cancer deaths per 100 breast cancers (27 versus 18). Despite declining breast cancer death rates in the US since 1990, this report concludes all racial groups have not benefited equally. Both individual and health system level recommendations for public health practice are suggested. At the individual level, timely follow-up and state-of-the-art treatment are recommended while performance-based reimbursement, an increase in information technology use, and reporting protocols for quality indicators were system level recommendations.

Studies have suggested African American women are more likely to have late-stage breast cancer at diagnosis than their non-Hispanic white counterparts. In a cross-sectional study, researchers explored the influence of race, ethnicity and individual SES factors on breast cancer stage at diagnosis (Lantz, Mujahid, Schwartz, Janz, Fagerlin, Salem et al., 2006). Using SEER data combined with survey results (n=1,700) in a sample of White, African American and Hispanic women, the researchers found minority women were more likely to be diagnosed with later stage breast cancer than were White women. Even when controlling for age and individual SES factors, the odds of early detection were significantly less among African American and Hispanic women. Further, the researchers found that differences in stage of breast cancer at diagnosis remained significant even when controlled for education and income.

There is some disagreement in the literature as to whether these differences are attributable to race or socioeconomic status or some combination thereof. One such study (n=5,719) specifically aimed to account for the influence of race and SES on stage at the time of diagnosis, treatment, and survival (Bradley, Given & Roberts, 2002). The researchers linked SEER data to Medicaid enrollment files for Michigan and found race was not significantly linked to unfavorable breast outcomes. However, they did find low SES was associated with late-stage breast cancer at the time of diagnosis, type of treatment received and mortality rates.

Maloney, Koch, Erb, Schneider, Goffman, Elkins & Laronga (2006) explored racial differences in newly diagnosed breast cancer in women of equivalent socioeconomic status. Though the sample was small (n=52), the researchers assessed multiple factors including age at the time of menarche, first live birth, menopause and diagnosis, pathologic size of the tumor, lymph node status, body mass index (BMI), type of diagnostic biopsy or surgery, tumor histology and receptor status, treatment and length of follow-up. Statistically significant differences were found in the age at the first live birth, where African American women were three years younger than the Caucasian sample. The only other significant findings included less use of diagnostic ultrasound and sentinel lymph node biopsy within the African American sample compared to the Caucasian group. The researchers acknowledged that the reasons for racial disparities in breast cancer mortality appear to be multi-factorial, but present poverty as one confounding factor in the analysis of this complex problem.

Sassi, Luft and Guadagnoli (2006) assessed whether mammography screening rates were correlated to improved breast cancer stage at diagnosis using data from five state cancer registries (n=379,917) and the Behavioral Risk Factor Surveillance System from 1990-1998. The researchers found that African American women, even with higher screening rates, had a lower proportion of early stage breast cancers in the sample. In other words, despite an increase in breast cancer mammographic screening in the 1990s which led to earlier diagnosis within each racial/ethnic group, was found to have the smallest positive effect was found among African American women.

Harper, Lynch, Meersoman, Breen, Davis and Reichman (2009) evaluated trends in socioeconomic and racial/ethnic disparities in breast cancer incidence, stage at diagnosis, screening, mortality and survival among women ages 50 and over using 1987-2005 SEER and NHIS data. Using four SES and five racial/ethnic groups, the researchers calculated both rate differences and rate ratios as measures of disparity among and between the subgroups. While most area-socioeconomic and race-ethnic disparities declined across all outcomes, race-ethnic disparities for mortality (24%) and 5-year mortality (17%) increased along with area-socioeconomic disparities in mammography use (161%). The results suggest improvement in these disparities over time but the researchers urge continued focus on research, treatment and policymaking.

An analysis of California Cancer Registry data from 2000-2010 explored the association of race/ethnicity and SES with the risk of breast cancer mortality among 179,143 diagnosed cases of stages 1-3 invasive breast cancer (Parise & Caggiano, 2013). Regression analysis was used to assess these previously reported disparities within each stage and SES group. For Stage 1 cases, no increased risk of cancer mortality was observed for any race or ethnicity when compared with whites across all SES groups. For both Stage 2 and 3 cases, African American women in the intermediate and high SES groups had increased risk of mortality compared to white women. This finding, if considered in isolation, supports breast cancer disparities among racial minorities across socioeconomic strata. Once adjusted for age, year of diagnosis, receptor status and tumor grade, the authors found less disparity concluding that the role race and ethnicity play are less clear and continued research is necessary (Parise & Caggiano, 2013).

Another California study examined SES and race/ethnicity as predictors of breast cancer stage at diagnosis (Flores, Davidson, Nakazono, Carreon, Mojica & Bastani, 2013). Though published in 2013, the study used California Cancer Registry data from 1990-2000, along with 1990 and 2000 US Census data. Rather than Stages 1-3, breast cancer stages in this study were identified as in situ, local, regional and distant diagnoses. Individual (age, race/ethnicity and marital status) and community characteristics (education and income by zip code) were used as socio-demographic determinants. Overall, there was an increase of in situ diagnoses with an associated decrease in regional and distant cancer diagnoses. This pattern held true for white and Asian/Pacific Islander women while African American women had a significant decrease only in distant-stage diagnoses. Hispanic women showed no significant changes in any stage of diagnosis during the studied time period. Therefore, an increase of in situ cases diagnosed among low income and low education zip codes was observed, leaving Hispanic women with the least improvement in breast cancer stage at diagnoses. These findings are important in guiding screening and education programs, given California's rapidly growing Hispanic population.

Rauscher, Allgood, Whitman and Conant (2012) surveyed mammography facilities (n=40) in the Chicago, Illinois metropolitan area to assess whether disparities in these services by race/ethnicity and health insurance exist. Facility characteristics, along with mammographic equipment and personnel were considered in this study. White women were significantly more likely than African American or Hispanic women to have mammograms at high quality facilities with digital mammography and breast imaging specialists. Similarly, women with private insurance were more likely than women without private insurance to have mammograms at academic facilities where these same favorable characteristics are observed. The results suggest that these disparities in obtaining high quality mammograms among African American and

Hispanic women and women without private insurance may contribute to breast cancer mortality disparities observed in these same groups. These studies represent a vast body of literature that have explored the impact of race and ethnicity, socioeconomic and insurance status on various breast cancer outcomes.

The 2012 Virginia Comprehensive Cancer Control Program report provides an overview of cancer incidence, staging, mortality and screening disparities by race in Virginia (Comprehensive Cancer Prevention and Control Project, 2012). Cancer incidence, based on 2007-2011 Virginia Cancer Registry data, was similar between African-American women (128.9 per 100,000) and White women (125.5). This does not follow the national trend whereby white women outpace African-American women in breast cancer incidence rates. Despite higher mammography screening rates (81% versus 78%), African-American women were more frequently diagnosed beyond a local stage and had a 39% higher mortality rate compared to their white counterparts (VDH, 2014).

Although significant gains have been made in improving screening rates across racial and ethnic groups, in part perhaps due to the NBCCEDP, disparities in breast cancer mortality continue to be evident. An extensive review of the literature, focused on racial disparities in breast cancer mortality, was conducted by Wheeler, Reeder-Hayes and Carey (2013). The researchers acknowledge many complex and overlapping factors contribute to breast cancer mortality disparities in the US. Despite decades of focused initiatives to remove barriers to screening, improve treatment regimens and provide necessary follow up, racial disparities in breast cancer mortality continue. Beyond tumor biology differences and other fixed factors such as race and age, disparities are also influenced by social and health system determinants. Wheeler et al. (2013) recommend clinicians, researchers and policymakers alike consider the factors influencing breast cancer treatment and outcomes when developing future strategies to minimize or eliminate breast cancer disparities.

The Impact of National Legislation and Policy

Due to these reported disparities in breast cancer screening and mortality, coupled with a favorable political climate, the National Breast and Cervical Cancer Mortality Prevention Act was passed as part of the Women's Health Equity Act of 1990 (Breast and Cervical Cancer Mortality Prevention Act of 1990, 1990). The Women's Health Equity Act of 1990 created a package of proposed legislation aimed to expand research, health care access and disease prevention activities specific to women, including the NBCCEDP. Although the NBCCEDP funds mammography screening, the NBCCEDP does not offer funds to those diagnosed with cancer for treatment, creating what Lantz termed a "treatment gap" (Lantz, Weisman and Itani, 2003). In response to this gap, along with substantial lobbying efforts from the National Breast Cancer Coalition (NBCC), the 106th Congress passed the Breast and Cervical Cancer Prevention and Treatment Act of 2000 (Breast and Cervical Cancer Prevention and Treatment Act of 2000, 2000). Through Medicaid eligibility expansion, the Breast and Cervical Cancer Prevention and Treatment Act (BCCPTA) provides health care coverage for the treatment of women diagnosed with cancer through the NBCCEDP.

Lantz, Weisman and Itani (2003) analyzed the BCCPTA through document analysis and semi-structured interviews of central figures (i.e. CDC representatives, advocacy and lobbying organization personnel and legislative staffers) involved in the process. The authors were prompted to conduct this investigation due to four unique reasons: 1) the legislation expands Medicaid eligibility based on a cancer diagnosis rather than particular income level; 2) all health care needs are covered for those diagnosed with cancer through the NBCCEDP; 3) the BCCPTA addresses a gap that was created by previous legislation to screen underserved individuals without providing resources to obtain appropriate treatment, and 4) the BCCPTA was largely championed by the National Breast Cancer Coaltion (NBCC), a non-profit, advocacy group organized in 1991 that continues to actively pursue pathways to cure breast cancer. To fill a similar gap, President George W. Bush signed PL107-121, The Native American Breast and Cervical Cancer Treatment Technical Amendment Act of 2001, which allows women eligible for Indian Health Services to be included in the BCCPTA.

The Healthy People initiative, established by the U.S. Department of Health and Human Services, has evolved since 1990, but its' primary goals remain to improve the overall health of U.S. residents and to eliminate health disparities. Healthy People 2010 established a goal of 70% of women ages 40-74 to be screened for breast cancer. With the goal unmet, Healthy People 2020 refined the goal, aiming for a ten percent improvement in breast cancer screening among 50-74 year old women (USDHHS, 2013).

Continuing this trend of focused attention on the health of the nation, historic legislation was passed March 23, 2010 in the form of the Patient Protection and Affordable Care Act (ACA). The core elements of the ACA align with HP2020 objectives, including those specific to improved access to breast cancer screening. The ACA aims to increase access to cancer screening services through expanded insurance coverage and the elimination of cost-sharing (CDC, 2013). The CDC notes that even with screening programs, many women still face barriers such as geographic isolation, limited literacy, lack of provider recommendation, limited self-efficacy, inconvenient facility hours, and language barriers (CDC, 2013). Though the legislation was passed in 2010, full implementation was not expected before 2015. Now, in 2015, most provisions of the law have been operationalized.

The National Prevention Council, borne out of the ACA, is comprised of 17 federal departments and chaired by the Surgeon General. As part of a National Prevention Strategy (NPS), developed by the Council, four strategic directions were established to guide efforts toward a “prevention-oriented” society. The four areas of focus are: 1) healthy and safe community environments, 2) clinical and community prevention services, 3) empowered people and 4) elimination of health disparities (National Prevention Council, 2010). The NPS calls for partners in prevention (community coalitions) to change the country’s focus to prevention and wellness. The strategy establishes key indicators and provides evidence-based recommendations for each. The NPS works cooperatively with HP2020 to achieve ten year benchmarks with a singular goal and that is, to increase the number of Americans who are healthy at every stage of life (NPC, 2010).

Plescia and White (2013) use the NPS framework to guide a discussion about the future of breast cancer screening. While providing background information about NPS, the authors use the four strategic directions to build a case to improve breast cancer screening rates in this new era of health care reform. Breast cancer screening rates remain low in certain groups with one in four women, ages 50-74, without a mammogram within two years. Plescia and White (2013) identify promising methods of outreach and case management designed to reach traditionally underserved communities, such as the use of peer educators or patient navigators. The authors draw from previous research to promote more patient-centered medical homes, educating and empowering consumers regarding the risks and benefits of breast cancer screening as a viable mechanism to encourage women to get appropriate screening. Further, the authors call upon public health leaders to use the NPS framework, along with the opportunity for increased participation through the ACA, to develop a national approach to control cancer.

National and State Breast Cancer Screening Programs

Using the social ecological model, the NBCCEDP is an example of how individual and population health outcomes are dependent on the coordination and interplay of social, organizational and policy influences. Administered by the CDC's Division of Cancer Prevention and Control, the NBCCEDP operates in all 50 states, the District of Columbia, U.S. territories and tribal organizations. Eligibility criteria limit services to uninsured or underinsured women aged 40-64 who have incomes at or below 250% of the federal poverty level, though states may further restrict this criterion. Priority populations are identified as those never or rarely screened and women aged 50-64 years. According to 2011 data, NBCCEDP programs screened approximately 14.3% of eligible women, and have diagnosed more than 54,000 breast cancers since its inception in 1991 (CDC, 2012).

Adams, Breen and Joski (2006) presented a longitudinal data analysis of the impact of the NBCCEDP on breast and cervical cancer screening utilization among white, Hispanic and African American women using BRFSS data from 1996-2000. The authors limited their study to two economic variables (insurance and income) and two policy variables (longevity and state funding) among women aged 40-64 years. The researchers calculated odds ratios and predicted probabilities of screening by income level, insurance status, longevity of the program and state funding levels. The predicted probability of the uninsured receiving mammography is lower among white non-Hispanic women (26%) than African Americans (38.4%) or Hispanics (35.0%). A positive effect, a greater screening rate probability, was observed among white non-Hispanic women based on the longevity of the state program. Though similar findings were observed in African American and Hispanic women, they were not statistically significant. Across all racial and ethnic groups, BRFSS data showed women that identify medical costs as a barrier had lower odds of screening mammography regardless of insurance status. The reader should note this study was conducted prior to the Affordable Care Act which when fully enacted guarantees free breast cancer screening services to age appropriate women (Patient Protection and Affordable Care Act, 2010).

Though established in 1991 to increase screening among low-income women, the CDC made recommendations to improve the program in 2000 as reported by Lawson, Henson, Bobo and Kaeser (2000). During the first ten years, the NBCCEDP provided more than one million mammograms to under or uninsured women with 48% provided to racial or ethnic minorities. Funding allows approximately only 15% of the eligible women in the U.S. to utilize these services. This remains a challenge of the program today. To maximize the use of resources, the NBCCEDP targets those women who have rarely or have never received a mammogram and women aged $\geq$50 years. The CDC set goals in four areas of focus: 1) screening initiatives, 2) case-management services, 3) professional education and training and 4) partnerships. To further these initiatives, the CDC developed a research agenda aligned with these same priority areas. The CDC continues to refine goals for the NBCCEDP based on current literature, legislation and data analysis.

Researchers Howard, Ekwueme, Gardner, Tangka, Li and Miller (2010) evaluated the impact of the NBCCEDP on breast cancer mortality rates based on 1990-2004 data. Their study was limited to women ages 40 to 64 years. The initial legislation that led to the development of the NBCCEDP was focused on the reduction of breast cancer mortality by improved screening. Early detection, diagnosis and treatment of cancer are associated with improved outcomes, including improved survival or conversely, decreased mortality. Using state level data, some evidence supports that the NBCCEDP led to a decrease in breast cancer mortality rates.

Specifically, there were 0.6 fewer breast cancer deaths for every 1000 women screened ages 40-64 years. Because they were unable to detect an effect for future years, the authors caution against using this data as strong evidence of program effectiveness.

Using a breast cancer simulation model, Hoerger, Ekwueme, Miller, Uzanangelov, Hall, Segel et al. (2011) evaluated NBCCEDP data between 1991 and 2006. Separate simulations were designed and performed for women who received mammograms through the national screening program, those that may have been screened without the program and those not screened at all. The authors' model indicated the program saved 100,800 life-years compared to those screened without the program and 369,000 life-years when compared to women without screening. Data suggest the NBCCEDP has reduced cancer deaths among 40-64 year old, medically underserved, low-income women.

While Hoerger et al. (2011) and Howard et al. (2010) focused their research on the impact of the NBCCEDP on breast cancer mortality, Escoffery, Kegler, Glanz, Graham, Blake, Shapiro et al. (2012) interviewed program recruitment coordinators in an effort to inventory and assess recruitment activities within the NBCCEDP programs. The interviews were conducted in 2008 to ascertain recruitment activities, use of evidence-based strategies aimed to improve community participation as well as barriers to such strategies. Recruitment activities (n=340) were categorized and two thirds were found to adhere to an evidence-based intervention (EBI). Barriers to using EBIs included funding shortfall, limited staffing, and questionable usefulness to priority populations. The authors recommended additional training and technical assistance for participating NBCCEDP agencies to improve compliance with evidence-based strategies and ultimately, increase participation of priority population women.

Virginia operates the NBCCEDP through its *Every Woman's Life* (EWL) program (Virginia Department of Health [VDH], 2013). Partnering with 32 enrollment sites, the EWL has provided 71,738 mammograms since 1998 (VDH, 2013). To be considered eligible for Virginia's *Every Woman's Life* federally funded breast cancer screening program, participants must be residents of Virginia, have incomes at or less than 200% of the Federal Poverty Level, have limited or no insurance and be between 40-64 years of age. State level data are available on the CDC website but are limited to the number of women served, screened and diagnosed along with demographic data, whereby the distribution of women receiving mammograms is provided by race/ethnicity and age groups (CDC, NBCCEDP Screening Program Summary-Virginia, 2013).

Breast cancer continues to be a major health problem in the US and in Virginia. The 2010 five year incidence rates still placed Virginia (124.5 per 100,000/yr) ahead of the national average (119.8 per 100,000/yr). Despite a vast pool of literature describing disparities in breast cancer screening and mortality, none are found using Virginia-specific NBCCEDP data. Current breast cancer data are derived from population surveillance surveys in combination with census data and national cancer databases. While these provide good estimates of breast cancer screening utilization and outcomes in Virginia, these data sources do not have the specificity to provide individual, regional and state level factors that influence breast cancer diagnoses in Virginia women who utilize the *Every Woman's Life* Program.

Preventive Health Behaviors

Preventive health behavior was defined by Kasl and Cobb (1966) as "any activity undertaken by a person who believes himself to be healthy, for the purpose of preventing or detecting illness in an asymptomatic state." Preventive health behaviors are broad in scope, and may include diet, exercise, smoking cessation and cancer screenings, including mammography. Under the umbrella of preventive health behavior, there is much research and subsequent literature focused on health information seeking behaviors. In order to effect behavior change, messages must be received and understood. Physician or providers have long been documented as the primary and most trusted source of health information (Schueler et al., 2008; Lemkau & Grady, 1998; Beaulieu et al., 1996). Literature suggests trusted sources of information vary among different socioeconomic and demographic groups.

Rains (2007) used data from Health Information National Trends Survey (HINTS) to evaluate both traditional and new sources of information, such as the World Wide Web (AKA the "Internet"). The results of the study suggest those distrustful of the information received from their providers also rated online health searches as "useless." Trust was identified as a key element for an individual to find health information useful.

In an extensive review of the health information seeking behavior literature, Cutilli (2010) concluded that many factors influence an individual's search for health information. Cutilli (2010) cited literature suggestive that the most trusted source of health information for African Americans is the health service professional. This coincides with findings from the qualitative study by Clark et al. (2014) that reported Black women of low socioeconomic status trusted physicians but sought additional sources of information to verify that information and support their health decisions. Other findings Cutilli (2010) summarized from the literature were that while older individuals utilized the Internet for information, decisions were made primarily with their physicians. Similarly, Hispanics and those with less education used supplemental sources of information (friends/family and TV/radio, respectively) to support their health decisions.

Utilizing both the 2005 and 2007 HINTS data, Redmond et al. (2010) sought to determine what source of information was associated with cancer screening behaviors. In this study, "mass media" was defined as the Internet, TV, and print media while the second category, "interpersonal," included health care providers and social networks. Though the most frequent source of health information among the 2005 survey respondents (n=5367) was friends and family, this was not predictive of meeting recommendations for health behaviors (diet, exercise, cancer screening). Across all respondents, those using print media (mass media) and community organizations (interpersonal) for health information were most likely to achieve health behavior benchmarks.

A 2003 study by Dutta-Bergman specifically investigated trusted online sources of health information. Though the personal doctor, medical university and federal government were found to be the most trusted online sources of information, Dutta-Bergman found significant differences across sociodemographic variables. Those with less education trusted the local hospital, while those with more education and higher incomes identified medical university and federal government websites as their most trusted sources of information.

Smith (2011) provides a straightforward analysis of data from the 2008 Anneberg National Health Communication Survey to evaluate the relationship between various sociodemographic factors and the use and trust of health information sources. The survey (n=3656) found significant differences exist when examined by sociodemographic variables (age, race/ethnicity, gender, level of education, household income, health status). Source of health information varied significantly by age groups. The oldest age group (>60 years old) was the most likely to trust health care providers, whereas the youngest group (18-29 years old) was the most likely to trust family and friends. Television and the Internet were the most trusted sources of health information among adults 45-59 years of age, and 30-44 years of age, respectively. The study found Whites, those with higher education and those with higher income levels were the most likely to use health professionals as the primary source of health information. Conversely, Blacks/African Americans, those with lower levels of education and those with lower income were more likely to use television. Family and friends were most often identified as trusted sources of health information among Hispanics, those with less education, and those with less income. Those most vulnerable to poor health outcomes (racial/ethnic minorities, low SES and less education) were the least likely to use health professionals for health information.

In a cross-sectional survey (n=157), Kratzke, Wilson and Vilchis (2013) studied rural women in New Mexico to explore health information seeking behaviors and their use of the Internet, cell phones and text messaging. Descriptive statistics highlighted television (58%) and magazines (46%) as the most utilized channel sources of obtaining breast cancer prevention information with the Internet (23%), brochures (23%), health fairs (22%), radio (13%) and newspaper (6%) completing the field. By a wide margin, the doctor (82%) was the most widely reported interpersonal source of breast cancer prevention information in this same group. Nurses (16%), clinic staff (21%), friends (10%) and family (8%) were among the others reported in this category. With a mean age of 60, most (87%) used cell phones and 47% reported to use text messaging. Where access to care may be limited, expanded strategies for communicating health care information for rural women may need to be tailored and may include cell phone and text messaging.

According to the National Academy of Science publication, *Speaking of Health: Assessing Health Communication Strategies for Diverse Populations*, significant health disparities persist and are expected to increase with the increase in population diversity in the US if effective actions are not implemented. Effective communication relies on understanding cultural and social differences that influence health behaviors among individuals, families and communities (National Research Council, 2002). Health educators, policy makers, and program administrators need to be aware of trusted sources of health information to deliver effective, tailored messages across Virginia to increase utilization of preventive health services.

These findings about trusted sources of health information are indicative of the varied and complex decision-making processes individuals must consider when engaging in preventive health behaviors, like breast cancer screening. Though ultimately an individual choice and an individual action, the groundwork to provide an impetus for action and access to services occurs on multiple fronts. Beyond education for the individual or community, modern health promotion depends on the successful interaction of government, state and regional entities to provide economic and structural support. The ecological perspective, while focused on the "big picture", stresses the importance of the integration of these factors (Rimer & Glanz, 2005).

Theoretical Framework

This is an expanded presentation of the socioecological model (SEM) as it pertains to this research. This theoretical framework is well-suited to account for the complex, intermingled layers of influence associated with a woman's decision and opportunity to obtain a screening mammogram. Ecological is defined as "organisms in an environment." The SEM is rooted in child development theory originally proposed by Bronfenbrenner in 1978. Bronfenbrenner developed the model to address micro to macro influences on children and their place within families, communities, and society (Bronfenbrenner, 1979). McLeroy, Bibeau, Steckler and Glanz (1988) first proposed the SEM for health promotion programs to move away from lifestyle focused change theories where victim-blaming had become common. The model, as depicted in Figure 1.0, continues to incorporate individual or intrapersonal factors such as knowledge, attitudes and beliefs but adds social and environmental factors outside the individual's level of influence. In addition to the individual factors, the SEM described by McLeroy et al. (1988) adds interpersonal, institutional, community and public policy factors as major influences. Interpersonal factors are comprised of an individual's social network, which may include trusted sources of health information such as health care providers, patient navigators, community health workers as well as family and friends. Health care systems and service providers, on the other hand, would be considered institutional or organizational factors. The EWL program and its many community partners would be categorized as organizational factors. Community level factors may include health fairs, media campaigns, employer initiatives and health promotion programs. Finally, the public policy layer of influence may be the most removed from the individual but may have the greatest influence. Public policy supports health initiatives with financial along with other important resources. This particular model is well suited for this research as influencing factors are considered at multiple levels.

Rimer and Glanz (2005) in the second edition of *Theory at a Glance: A Guide for Health Promotion Practice* identify two key principles of the ecological perspective. First, behavior affects and is affected by multiple layers of influence as described by McLeroy et al. (1988). Second, a concept termed "reciprocal causation," is where individual behavior shapes and is shaped by the social environment in which the individual exist.

Intrapersonal or individual factors of the SEM include knowledge, attitudes and beliefs (KAB) as well as biological and economic factors. There is a plethora of literature devoted to KAB about breast cancer and breast cancer screening, largely stratified by race, ethnicity, SES or geographic locale. Adequate knowledge, positive attitudes and beliefs may only result in action if an individual has some level of self-efficacy. This is generally described as the confidence in one's ability to take action (Bandura, 1977). A study (n=194) by Allen, Sorensen, Stoddard, Colditz and Peterson (1998) revealed that self-efficacy and strong social support were significantly related to an individual's intention to have a mammogram. The authors recommended health program planners use interventions that build women's confidence to discuss mammography with health providers. Self-efficacy is at the core of the social ecological model, though not explicitly described. An individual's intent to have a mammogram will fail unless access to affordable and convenient breast cancer screening services are available.

Individual behavior is influenced by one's knowledge, attitudes and beliefs as well as the influences of others with which the individual identifies. Allen et al. (1998) recommended interventions among social networks may promote mammography use. This recommendation addresses the second, interpersonal level of the SEM. The social network includes friends, family, coworkers, health professionals and others, according to Rimer and Glanz (2005). At this level, providers make screening recommendations to their patients and community health workers or patient navigators work to remove barriers to screening. Beyond the individual and their social (interpersonal) network resides the organizational level of influence. The EWL program is an example of a prevention activity implemented at the organizational level. With coalition partners throughout the Commonwealth, the EWL program provides structure and support for breast cancer screenings.

Beyond the organizational level activities resides the community level of influence. Media campaigns and community health programs are representative of interventions appropriate at this level (CDC, 2013). Structure and financial resources to conduct such screening interventions are generally provided by the outermost level of influence, public policy. For the EWL program, Public Law 101-354 and subsequent legislation continues to provide necessary structure and support.

SEM has been embraced by governmental agencies and is used for the CDC's National Breast and Cervical Cancer Early Detection Program (NBCCEDP) and US Department of Health and Human Services' Healthy People 2020 initiative. The model addresses the institutional, community and policy levels of influence on public health, improving our ability to reach more people. Lieberman, Golden and Earp (2013) raise questions regarding the effectiveness as well as the ethics of endorsing structural approaches to health promotion. The authors caution that structural approaches may help eliminate health disparities, but only if offered in and embraced by traditionally medically underserved communities with the greatest need. The EWL program is specifically designed to meet this need.

Mittler, Martsolf, Telenko and Scanlon (2013) address both policymakers and practitioners to improve health care through consumer engagement initiatives using a combination of the SEM and the transtheoretical model of individual behavior. The authors describe consumer engagement in health care as two-pronged: "engaged" or performed behaviors and "activation" or capacity to perform behaviors (Mittler et al., 2013). The authors used this theoretical framework to analyze an existing community engagement program, classifying targeted behavior types as well as individual, group and community influences. Mittler et al. (2013) propose their framework as a structured method to evaluate pre-existing programs for policymakers and practitioners by alerting them to various influences that may impact future program goals.

Findings from this research provide unique feedback for the EWL program and its community partners. Early detection is a primary initiative of the NBCCEDP with the targeted behavior being the screening mammogram. This study reports early detection rates, stratifies trusted sources of health information by level of influence and explores various sociodemographic and preventive health behaviors that may influence health outcomes of women that utilize the EWL program.

CHAPTER 3

METHODOLOGY

Introduction

This chapter provides a summary of the methods and procedures used to address the research questions. It includes the research problem, research design, research questions, source of data, unit of analysis, variables, and data analysis. This research was approved by the Virginia Commonwealth University Institutional Review Board (IRB) Appendix A. Additionally, IRB approval was obtained from the Virginia Department of Health with a written Data Use Agreement (Appendices B and C).

Research problem

Breast cancer continues to be a health risk in the United States, with a 12% lifetime risk among women (ACS, 2015). The 2005-2012 incidence of breast cancer in Virginia (124.0 cases per 100,000) closely match the national average of 124.3 cases per 100,000. While breast cancer incidence between white and African-American Virginians are comparable (124.2 and 126.1, respectively), disparities in survival exist with African American women experiencing a 40% higher mortality rate than their white counterparts (VDH, 2014). Early detection is closely linked with improved survival when diagnosed at an early stage. Virginia Cancer Registry statistics from 2005-2012 indicate white women (63%) were more likely to be diagnosed with a local stage of breast cancer than African American women (53%) during that same timeframe. Frequently encountered in the literature, income is intermingled with other variables and is reported on census-tract level whereas these data provide self-reported individual-level incomes. Education is found as a proxy for SES (Council on Virginia's Future, 2015). Beyond income, the term “socioeconomic status” incorporates factors such as occupation, education and housing to complete the picture. Sapolsky (2005) and others have recognized that “starting with the wealthiest stratum of society, every step downward in SES correlates with poorer health.” As established per federal policy and state eligibility requirements, the entire sample studied are considered low income or low SES. Do breast cancer disparities persist among this group of women? How does this population of women discover affordable breast cancer screening opportunities? Findings or the absence of significant findings from this state and regional specific data analysis may inform the work of providers, program administrators, community partners and policy makers.

Design

This non-experimental, descriptive study explored existing data from the Cancer Statistics and Tracking (CaST) system which maintains the Every Woman’s Life (EWL) client information by the Virginia Department of Health (VDH). The intent of the research was to explore the relationship of various sociodemographic determinants of health and preventive health behaviors, on an individual’s breast cancer diagnosis, breast cancer stage at the time of diagnosis and their source of information to the EWL screening mammography program. Thousands of uninsured and underinsured women have secured mammograms through this program since its inception in 1997.

Research questions

Within the parameters of data from the Virginia Department of Health’s Every Woman’s Life program database, what factors can be identified that may affect breast cancer diagnoses among low income women 40-64 years old?

RQ1. What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and prior mammography and cancer diagnosis among women 40-64 years of age utilizing *EWL* services?

RQ2. What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and prior mammography and cancer stage at the time of diagnosis among women 40-64 years of age utilizing *EWL* services?

RQ3. What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and source of information among women 40-64 years of age utilizing *EWL* services?

Source of the data

The Virginia Department of Health is a state government agency. The EWL program operates under the Office of Family Health Services and within the Division of Prevention and Health Promotion (VDH, 2015). The EWL program began in 1997 utilizing NBCCEDP funds to provide low-income women access to breast and cervical cancer screening to promote early detection. Current funding of the program allows approximately 10% of the eligible population to receive free screenings. Published priority populations include minorities, economically deprived and women over 50 years of age (VDH, 2015). There are 32 EWL enrollment sites across the state that coordinates with approximately 250 healthcare providers to obtain clinical services.

Data source

Secondary data analyses of the VDH Every Woman's Life Cancer Statistics and Tracking (CaST) database examined the association of various sociodemographic determinants and preventive health behaviors on breast cancer diagnosis and stage at the time of diagnosis.

Along with demographic elements (age, race, county of residence, and primary language), the data set included two health behaviors (prior mammogram and smoking status). Measures of socioeconomic status represented in the data set included income, the number of persons living on that income, as well as the highest level of education attained. The date and site of enrollment were provided, along with the mechanism for hearing about the EWL program. Finally, there were multiple variables related to breast cancer, including the final diagnosis, tumor histology and staging information. The CaST database included 98,250 records of women who enrolled in the Every Woman's Life program from 1998 to 2012. This included 57,763 records with duplicate unique identifiers representing women who obtained more than one mammogram during this same timeframe. For these repeat users, only the initial entry was retained for analysis. An additional 5,545 records were excluded for those outside of the age or federal funding source requirement. The resulting sample size for this study was 34,942 Virginia women between the ages of 40-64 who utilized mammographic services funded through the NBCCEDP in the 1998-2012 timeframe.

Variables

Outcome or dependent variables in the study include the diagnosis of breast cancer, the stage at the time of diagnosis and information source. Predictor or independent variables include the sociodemographic determinants of age, race, education, income, geographic locale, language and a preventive health behavior, receiving a prior mammogram. A second preventive health behavior, intent to stop smoking, was removed from the model as it was found to reduce the number of cases in the analysis to less than ten. Upon receipt of the data, each parameter was verified prior to importing into IBM SPSS® Statistics 23 software package. Initial analysis of the study variables determined frequencies and aided in subsequent allocation strategies.

Dependent variables in the first two research questions are “a breast cancer diagnosis” and the “stage at the time of diagnosis”, outcomes central to the mission of the EWL breast cancer screening program. Both of these dependent variables are categorical. Breast cancer diagnosis is a dichotomous categorical variable with only two discrete possibilities where participants either are or are not diagnosed with breast cancer. The intent, prior to data analysis, was to treat stage at the time of diagnosis as a dichotomous variable with “early stage” and “not early stage” as the two levels. Early stage was to be defined, in alignment with National Cancer Institute guidelines, as those with Stage 0, I, IA, IIA, IIB or IIIB breast cancer. All others were to be categorized as “not early” for the purposes of this study. However, AJCC staging completed for only 40% (460/1143) of those diagnosed with breast cancer forced an alternate categorization scheme. Using the EWL supplied “breast final diagnosis,” complete for 100% of those diagnosed, staging was then assigned as either “Stage 0” or “invasive”. Stage 0 was comprised of those diagnosed with ductal carcinoma in situ (DCIS) or lobular carcinoma in situ (LCIS), both considered to be non-invasive (ACS, 2015). Those identified as “invasive” were assigned into the category by the same name. In research question three, the dependent variable is “source of information” was categorized as either provider or non-provider, based on responses to the question, “How did you hear about the EWL program?” Documented preferred sources of health information and referral are varied in the literature with Smith (2011) finding older adults, Whites, those with more education and higher incomes more likely to trust health professionals as trusted sources of health information. Sources of health information and referral within the EWL sample extend into each level of the socioecological model as individual responses ranged from “self” (individual), “nurse, family, friend” (intrapersonal), “health clinic” (organizational), and “radio/TV/newspaper” (community) though in the final analysis these categories were collapsed into provider and non-provider to align with the literature.

Independent variables were selected based on the review of the literature. Categorical independent variables included race, as defined by the Office of Budget and Management Statistical Policy Directive No. 1, (0=White, 1=Black/African American, 2=American Indian/Alaska Native, 3=Asian, 4=Pacific Islander/Native Hawaiian, 5=unknown), income level (0=200% FPL, 1=150% FPL, 2=100% FPL), geographic location (VDH health districts, coded 1-35 in alphabetical order), language (0=English, 1=Spanish, 2=Other/IndoEuropean, 3=Asian/Pacific Islanders, 4=Other) as defined by the “Primary Language Code List” published by the US Census Bureau (Appendix F), and education (0=<9th grade, 1=Some high school, 2=High school graduate or equivalent, 3=Some college, 4=Unknown) predetermined from the self-reported client eligibility form. Self-reported income, along with the answer to “How many people live on this income including yourself?” was used to construct and stratify income levels (200%, 150% and 100% FPL) based upon historical federal poverty level guidelines (Appendix G), which varied annually. Virginia has 35 established health districts. The 2007 American Community Survey (Bishaw & Semega, 2008) identifies Fairfax County among the top ten wealthiest counties, based on median household income, in the United States. To provide a meaningful comparison among health districts, the Fairfax health district was selected as the reference group in the analyses. Based on city or county of residence, participants were assigned to their appropriate health district (Appendix H). Subsequently, participants were parsed into their respective EWL regions (Northwest, Northern, Central, Southwest and Southeast) by “enrollment location” to use when sample size dictated a collapse in variable stratification, recognizing this sacrifices variability. The use of five EWL regions, rather than 35 health districts, was used for the analyses for research question two. Similarly, the same was done for race (0=White, 1=Black/African American, 2=All others) and language (0=English, 1=All others). Age was treated as both a continuous variable (40-64) and categorical variable (40-49, ≥50) in the analyses, requiring two separate models. Age as a continuous variable provided full information and maximum variability. The decision to create a binary categorical age variable with a division at 50 years of age was based on the USPSTF recommended age to initiate breast cancer screenings and the EWL's recommended age threshold for priority screening recruitment efforts (VDH, 2012). Having a prior mammogram was coded (0=No, 1=Yes, 2=Unknown) according to self-reported information on the client eligibility form. The study variables are further identified and categorized in Table 3.1.

Table 3.1 Study Variables

Name of Variable	Type of Variable	Categories
Dependent Variables		
Breast Cancer Diagnosis	Categorical	Yes/No
Breast Cancer Stage	Categorical	Early/Not Early
Source of information	Categorical	Provider/Non-provider
Independent Variables		
Sociodemographic determinants		
Race	Categorical	White, Black, Asian, American Indian/Alaskan, Native Hawaiian/ Pacific Islander, Other
Age	Continuous	40-64
	Categorical	40-49, 50+
Education	Categorical	<9th grade, some high school, high school graduate or equivalent, some college or higher, unknown
Income	Categorical	200% FPL; 150% FPL; 100% FPL
Geographic locale	Categorical	35 Virginia Health Districts
Language	Categorical	English, Spanish, Indo-European, Asian/PI, Other
Preventive Health Behaviors		
Prior Mammogram	Categorical	Yes/No/Unknown

Unit of analysis

The unit of analysis was women who utilized federal funding for mammographic screening services through the EWL program. Program eligibility requirements specify participants to be a certain age (40-64), residents of Virginia, born female, incomes at or less than 200% FPL, with limited or no insurance (VDH, 2015). A census sample of all women who initiated a “breast cycle” in calendar years 1998 to 2012 was obtained from the VDH in an Excel® spreadsheet format. Selected parameters of the EWL database included: date of birth, race, language, county of residence, enrollment site, income (and number of persons in the household), level of education, prior mammogram, smoking status, source of EWL information, final diagnosis and stage at the time of diagnosis. With the exception of final diagnosis and staging information, the elements are self-reported by the participant using a client eligibility form (Appendix E). The client eligibility form has a combination of open-ended and structured questions.

Data Analysis

Descriptive and multiple logistic regression statistics were the method of statistical analyses conducted using IBM SPSS® 23 software. Descriptive statistics included frequencies and cross-tabs which were important in identifying missing cases as well as establishing coding strategies and referent groups for the regression analyses. A correlation analysis was performed to assess covariance or conversely, the independence, among the variables. Correlation coefficients, between negative one and positive one, describe the direction and strength of the relationship that may exist among variables (Field, 2009, p.783). Independent variables with statistically significant relationships with the dependent variables were included in the statistical model.

Inferential statistical analyses were conducted to address the research questions. The results, with an appropriate level of caution based on power and effect size, allow inferences to be drawn about a population based on the sample data. Logistic regression is the statistical analysis best suited for the focus of the research questions, as the dependent variables are categorical and the predictor variables are either continuous or categorical (Field, 2009). Logistic regression is widely used in health sciences research with the primary aim of developing the best model to describe the association between the dependent and independent variables. Specifically, logistic regression was conducted for research questions one, two and three since the dependent variables (breast cancer diagnosis, breast cancer stage and source of information) are dichotomous.

Through the logarithmic (logit) transformation of the linear regression model, logistic regression allows non-linear relationships of categorical data to be expressed in a linear way. In logistic regression, the analysis provides the probability (between zero and one) of the dependent variable occurring rather than predicting the actual value of the dependent variable as in linear regression. A value close to zero means the outcome (dependent variable) is unlikely to occur whereas a value close to one means the outcome is very likely to have occurred. An odds ratio (OR) is a measure of the likelihood of an outcome occurring among those with a particular independent variable compared to a referent group. Odds ratio help provide meaningful interpretation of logistic regression results, as it approximates relative risk (Hosmer, Lemeshow & Sturdivant, 2013).

To build the best fitting logistic model, independent variables were assessed for collinearity, interactions, confounding and ultimately, significance. Decisions to include or exclude each variable in the model were informed by the literature and statistical analyses. Bivariate analyses were conducted to test each independent variable’s association with the dependent variable (main effect). The Wald chi-square statistic was used to assess significance, where a large Wald score represents a significant contribution in the model. Collinearity is not desirable among independent variables. As collinearity increases, it becomes more difficult to assess which variable is responsible for changes in the outcome (dependent variable). Correlation coefficients were used to examine the collinearity among independent variables. According to Allison (2012), a correlation with Pearson coefficient $(R)^2$ of .6 should be considered for exclusion from the model, though there is no explicit rule for the cut-off value. The researcher tested for main effects between each of the independent variables with the dependent variable. Lastly, for variables not found to be effect modifiers, confounding was evaluated. Upon initial regression analysis, the independent variables were evaluated for confounding factors. If the odds ratio changes more than 10% between the crude and fully adjusted (stratified) model, the variable is considered a confounder and is to be included in the final model. When confounding is present, the relationship between the independent and dependent variable is “distorted” because of the impact of a third variable (Aschengrau & Seage, p. 288). An odds ratio greater than one means the odds of the outcome occurring increase. All independent variables, except age, were found to be confounders where there was a greater than 10% change between the crude and fully adjusted odds ratios. Both crude and fully adjusted odds ratios are presented, as is common in epidemiologic research. Confidence intervals and *p*-values are reported to provide additional information about the role of chance in the results. Logistic regression models were built for each of the research questions using these methods of including or excluding variables. The log likelihood statistic (-2LL) is used to assess the fit of the logistic regression model. It is desirable to have a small value, representing a “good fit” where there is only a small amount of unexplained information (Field, p.267). There are multiple measures of significance that may also be used to evaluate the significance of the model including, the Hosmer and Lemeshow Test, Cox and Snell’s R^2 , and Nagelkerke’s R^2. Statistical power is the term used to assess the ability to detect a significant relationship (Aschengrau & Seage, p.180). Power analysis is useful for study design though for a case, like this study, where the researcher is limited to the sample provided a sensitivity power analysis can be used to calculate effect size, assuming power level is pre-established (Hunt, 2015). To reveal small differences between groups, a large sample size is needed. Missing data, by reducing the effective sample size, decreases statistical power.

Missing data reduced the available sample used in the statistical analysis for research question one whereby 62% (n=21,763) of the participants had left the question "What is the highest grade of school you completed?" unanswered. In post hoc analyses, chi-square tests were performed to compare the frequencies between those reporting an educational level and those not reporting an educational level. With all variables showing statistical significance, the same regression models for research question one were run for the women with no educational status reported in order to compare findings between the two groups. Additionally, it was decided to combine Pacific Islander/Native Hawaiian (n=13) with the Asian (n=652) race category for these analyses. This was reasonable, given Asian and Pacific Islanders were already combined for the language variable. Those results are reported in Chapter 4.

Model assumptions

According to Wright (1995) five conditions are needed for a logistic regression model to be valid. The first assumption requires the dependent variables to be dichotomous. The three dependent variables in this study (breast cancer, breast cancer stage, source of information) all meet this requirement. Second, there must be independence of observations where no individual appears twice. By checking for duplicate EWL unique identifiers, this assumption was met. The specificity assumption (third) dictates that only significant measures are included in the model. Though procedures were followed to test for individual variable contribution to the model, some variables without statistical significance were kept based on their importance in the body of literature reviewed. The fourth assumption demands that within the variable strata there must be clear and exclusive group membership. That is, a case may not have membership in more than one category. Women receiving breast cancer screening mammograms either are or are not diagnosed with breast cancer, two separate and distinct classifications. Among those diagnosed with breast cancer, staging category strategies that were adopted place women in either the Stage 0 (non-invasive) category or the invasive cancer category. Lastly, Wright (1995) indicates larger samples are required for logistic regression when compared to linear regression analysis. He cites Aldrich & Nelson (1984) as prescribing a minimum of 50 cases per independent variable for improved accuracy in the model. With 34,942 cases, it was expected to meet this assumption. However, as will be discussed in Chapter 4, there were independent variables with insufficient representation in all strata which forced a reassessment and subsequent collapse of the variables response categories.

Delimitations

This exploration of EWL data may illuminate meaningful relationships between the variables studied; however it is important to delimit any findings to the sample included in the study. These data are limited to the women who utilized the EWL breast cancer screening program in calendar years 1998-2012. It is assumed they met eligibility criteria. The VDH estimates funding by NBCCEDP provides free mammograms for approximately ten percent of eligible Virginia women. Additionally, the sample is delimited to geographic areas served by the 32 EWL enrollment sites.

CHAPTER 4

RESULTS

This focus of this chapter is to present a summary of the statistical findings. Females (N=34,942) included in the analyses were between the ages of 40-64 who received a federally funded mammogram through Virginia's *Every Woman's Life* program in calendar years 1998 through 2012. Complete data for all desired measures were not available for the entire sample and adjustments were made as described in Chapter 3. Both descriptive and inferential statistical analyses are presented in this chapter.

Demographics by age

The average age of the sample was 53 years of age (Figure 4.1). There is a notable spike at 50 years of age, coinciding with the USPTF's recommended age threshold to start mammography screening and the published priority population for the *Every Woman's Life* Program. When viewed by category, almost 75% (25,901) are 50 to 64 years of age while the remaining 25% are in the 40 to 49 age group. Table 4.1 displays sample demographics by age, race, language, education, geographic region, and income level.

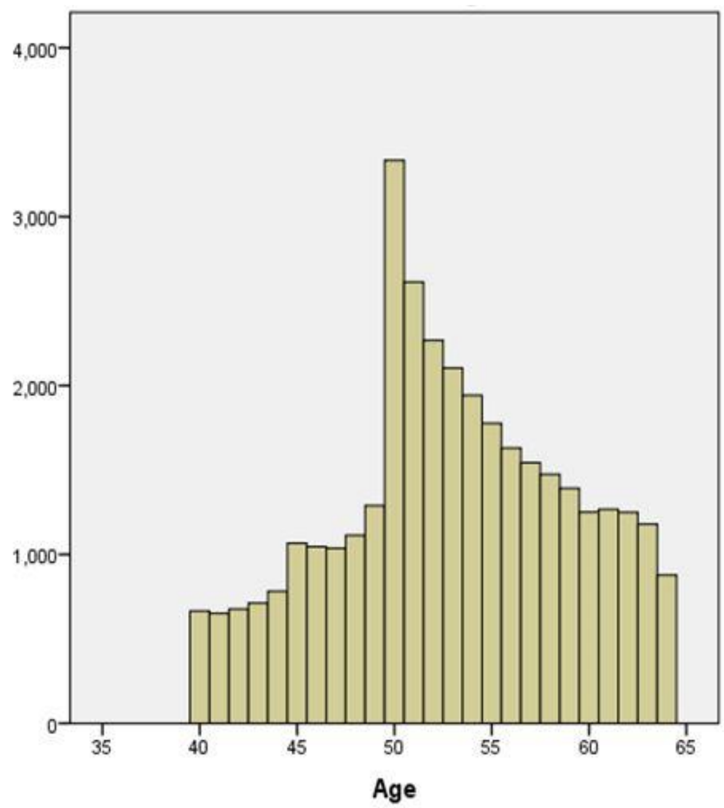


Figure 4.1 Sample distribution around age
Mean = 52.87, SD = 6.036, N=34,942

Demographics by race

The racial demographics of the participants were White (56.3%), Black (33.8%), Asian (4.3%), American Indian/Alaska Native (<1.0%), Native Hawaiian/Pacific Islander (<1.0%), and Other/unknown (5.0%).

Demographics by language

In the sample, over 90% (31,640) identified English as the language spoken daily with Spanish (4.9%), Asian/Pacific Islander (3.2%), IndoEuropean (<1%) and all others (<1%) representing the remainder. When stratified by EWL region (Appendix I), the Northern region reports the most diversity with more than 50% of the participants speaking a language every day, other than English. To further illustrate, Figure 4.2 displays languages, other than English, spoken within each region.

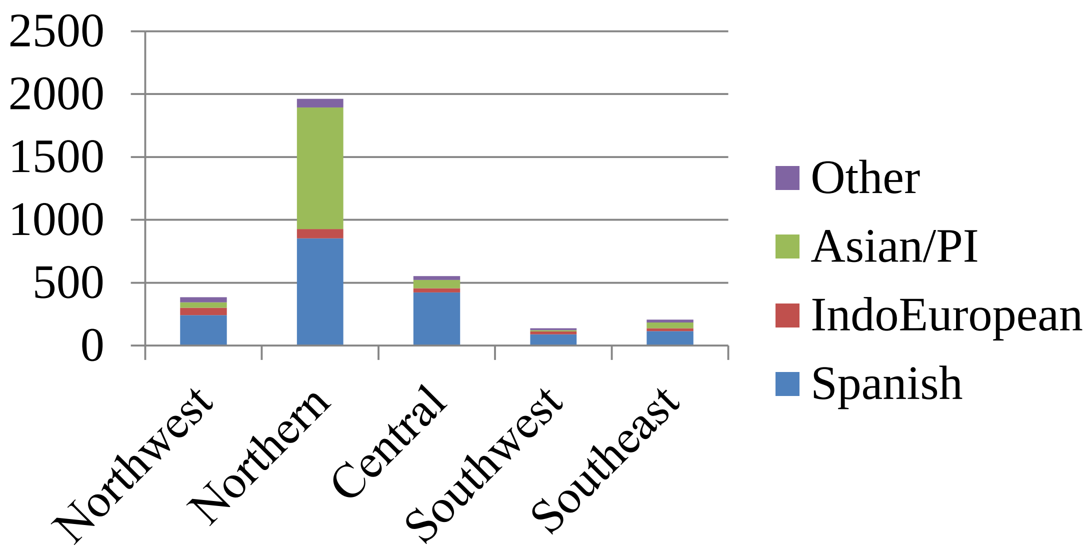


Figure 4.2 Non-English language frequencies by region

Demographics by education

Over 60% of the participants left the question “What is the highest grade of school you completed?” unanswered, leaving approximately 40% to include in the initial analyses. In fact, education was removed from the regression model for research question two and three due to the aforementioned missing cases. Of the remaining participants 3.3% reported having completed less than 9th grade, 5.6% some high school, 16.8% high school graduate or equivalent and 10.9% some college or higher and 2.3% unknown.

Demographics by geographic region

The Virginia Department of Health’s *Every Woman’s Life* Program divides the state into five regions, specific service areas are detailed in Appendix J. Geographically, the Southeast region had the highest percentage of women (30.2%) represented in the sample followed by, the Northwest (24.6%), Southwest (24.3%), Central (10.7%), and Northern (10.1%) regions.

Demographics by income level

Though all participants in the EWL program are by eligibility requirements considered “low income,” the sample was divided to differentiate levels of poverty and test their significance, if any. Federal poverty guidelines (Appendix G), published by US Health and Human Services, outlines the criteria which are adjusted annually. Within the sample, 77.2% were classified into the 100% times the published FPL for the year in which services (mammogram) was received. This group would be considered to have the least “wealth” among the participants. To complete the sample, 14.1% had income at 150% FPL with the remaining 2.1% in the top tier at 200% FPL.

Table 4.1 Sociodemographics

N=34942	n (%)[a]
Age	
40-49	9041 (25.9)
≥50	25901 (74.1)
Race	
White	19681 (56.3)
Black	11822 (33.8)
American Indian/Alaskan Native	185 (<1)
Asian	1513 (4.3)
Native Hawaiian/Pacific Islander	17 (<1)
Other/unknown	1724 (5)
Language	
English	31640 (90.6)
Spanish	1722 (4.9)
IndoEuropean	241 (<1)
Asian/Pacific Islander	1132 (3.2)
All others	150 (<1)
Education	
<9th grade	1164 (3.3)
Some high school	1972 (5.6)
High school graduate or equivalent	5860 (16.8)
Some college or higher	3794 (10.9)
Unknown	389 (1.1)
Left blank	21763 (62.3)
Geographic region	
Northwest	8605 (24.6)
Northern	3529 (10.1)
Central	3747 (10.7)
Southwest	8495 (24.3)
Southeastern	10566 (30.2)
Income levels	
100% FPL	750(2.1)
150% FPL	4941 (14.1)
200% FPL	32668 (93.5)
Unable to calculate	2274 (6.5)

[a] percentage may not equal 100% due to rounding

Logistic regression

The logistic regression model predicts the relationship between one or more independent variable(s) and the dichotomous dependent variable. Independent variables selected are evaluated for collinearity, confounding and interaction prior to inclusion in the regression model. Assessing frequencies and establishing stratification strategies are dependent on sample size and whether the variables are significantly correlated. Univariate analysis of each independent variable's main effect established its importance within the model. Further, the interaction of two or more variables can also be assessed. Once independent variables are selected, the iterative process of fitting the regression model begins.

The alpha level, commonly set at the 0.05 significance level, represents the probability (5%) of committing a Type I error where the researcher rejects the null hypothesis when, in fact, it is true. If an independent variable is found to have a *p*-value less than the preselected significance level, then it is meaningful and should be included in the regression model. Each regression coefficient (*B*) represents the change, in the form of a slope, the variable has in response to one unit of change in the dependent variable. The coefficient is specific to the individual independent variable, holding all other predictor variables constant. When the coefficient is large, the standard error (SE) increases as well.

The Wald (X^2) statistic provides another measure to estimate the unique contribution of each independent variable to the regression model. A large Wald statistic indicates it contributes largely to the model and should be included in the final regression analysis.

The odds-ratios, *Exp B*, are reported with their respective 95% confidence intervals. A wide confidence interval indicates low precision whereas a small confidence interval provides a higher level of confidence. Reference groups were established to aid in the odds-ratio (OR) interpretation. The odds ratio (OR) is another way to assess the strength of the relationship between the independent variable and dependent variable, as compared to the reference group. An odds ratio of 1 is assigned to the reference group. Therefore, an OR less than one indicates the relationship is less likely to occur and conversely, an OR greater than one indicates the event is more likely to occur.

Measures provided in the SPSS regression output to assess the overall performance of the regression model include the classification table, -2LL, pseudo *R* squares and the Hosmer-Lemeshow statistic. The classification table is used to estimate the percentage of occurrences correctly predicted by the model. The -2LL, which is the product of negative two times the log of the likelihood, is always a positive number. The smaller the -2LL number, the better the fit of the regression model is indicated. The two pseudo *R* squares, the Cox and Snell and the Nagelkerke, are used as effect size measures of the model. There is debate surrounding the use of *pseudo*-R^2 in logistic regression, since it was designed for linear regression analysis. The Hosmer-Lemeshow statistic is used to assess goodness of fit of the model. The logistic regression model for research question one is as follows:

---

*Log (odds of having a breast cancer diagnosis)= -5.387 -.192*Race(Black)-.511*Race(American Indian/Alaska Native)-.171*Race(Asian)+1.681*Race(Native Hawaiian/Pacific Islander)+.050*Race(All others)+.049age in years+.129*Education(some high school)+.114*Education(high school graduate or equivalent)+.217*Education(some college or higher)+.564*Education(unknown)-.099*Income(150%FPL)+.218*Income(200%FPL)-.125*Language(Spanish) +.620*Language (Other/IndoEuropean)-1.045*Language (Asian/Pacific Islander)+.104*Language(All others)-.756*Health District(Alleghany)-.490*HD(Arlington)-.798*HD(Central Shenandoah)+.149*HD(Central Virginia)-.641(Chesapeake)-.379*HD(Chesterfield)-.223*HD(Chickahominy)-.722*HD(Crater)-.997*HD(Cumberland Plateau)-1.107*HD(Eastern Shore)+.216*HD(Alexandria)-.160*HD(Hampton)-.349*HD(Henrico)-2.230*HD(Lenowisco)-.797*HD(Lord Fairfax)+.271*HD(Loudoun)-.938*HD(Mount Rogers)-1.084*HD(New River)-.475*HD(Norfolk)-.021*HD(Peninsula) +.484*HD(Piedmont)+.150*HD(Pittsylvania)-.544*HD(Portsmouth)-.591*HD(Prince William)-.664*HD (Rappahannock) +.100*HD(Rappahannock Rapidan)-.339*HD(Richmond)-.292*HD(Roanoke) +.201*HD(Southside)-.601*HD(Thomas Jefferson)-.244*HD(Three Rivers)+.812*HD(Virginia Beach) +.121*HD(West Piedmont)+.087*HD(Western Tidewater)-.321*Prior mammogram(Yes)+.272*Prior Mammogram(unknown)where the odds=p/(1-p) and p is the probability*

Research question one (breast cancer diagnosis)

Research question one uses multiple logistic regression models to evaluate the relationship of the independent variables (age, race, language, education, geographic locale and prior mammogram) on the likelihood of breast cancer diagnosis within the sample. A large sample (n=12045) with complete data on the independent and dependent variables was available for analysis. Initial descriptive statistics were conducted and evaluated. The independent variables were assessed for collinearity. The correlation between variables was analyzed and is shown in Table 4.2.

Table 4.2
Correlation between independent variables

	Race	Age	Education	Income	Language	Prior mammogram	Health district
Race		-.019**	-.056**	.025**	.475**	-.048**	-.055**
Age			-0.008	-0.006	-0.003	.108**	-0.003
Education				-.021*	-.087**	.051**	.066**
Income					-.021**	-.033**	.027**
Language						-.096**	-0.245**
Prior mammogram							.043**
Health district							

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Race and language shows a moderately positive correlation (r (34,942) = .475, $p \leq .05$). The remaining variables showed weak correlations, ranging from -.245 to +.108. No variable was significantly correlated with age except with "prior mammogram," which showed a positive correlation (r (34,942) = .108, $p \leq .05$). All other variables tested significant ($p \leq .01$) excluding the correlation between education and income level ($p \leq .05$).

Interpreting the odds-ratio (Table 4.3) for each one year increase in age, women are 1.050 times more likely to receive a breast cancer diagnosis. In a second model (Appendix K), using the 50+ group as a reference category (OR=1), the 40-49 year old group were 25% less likely to be diagnosed. Both of these were found to be statistically significant at $p = \leq .05$. The odds-ratio demonstrated that women who reported no prior mammogram (referent category, OR=1) have a higher likelihood of being diagnosed with breast cancer than those who reported having a prior mammogram (OR=.724, 95% CI=.539-.973) but are less likely than the unknown group (OR=1.328, 95% CI=.847-2.082). Using the lowest income and most represented group, 100% FPL as the referent group (OR=1), odds-ratio demonstrate the 150%FPL (OR=.906, 95% CI=.676-1.213) are less likely to be diagnosed with breast cancer while the 200% FPL (OR=1.243, 95% CI= .685-2.258) are 1.243 times more likely than those at the 100% FPL income level. Being Native Hawaiian/Pacific Islander (OR=5.369, 95% CI=1.116-25.831) increases the likelihood of being diagnosed with breast cancer compared to the White (OR=1) reference category. Though statistically significant, the large confidence interval indicates a low level of precision which is reasonable given the Native Hawaiian/Pacific Islander group are the most underrepresented racial group (n=17) making up less than .05% of the total sample. Speaking a language, other than English (OR=1) revealed mixed findings. Those in the Other/IndoEuropean (OR=1.858, 95% CI=.695-4.966) category and All others (OR=1.110, 95% CI=.312-3.950) were more likely to be diagnosed with breast cancer. Spanish (OR=.325, 95% CI=.154-.739) and Asian/Pacific Islander (OR=.352, 95% CI=.109-1.136) were less likely to be diagnosed with breast cancer compared to their English speaking counterparts, with Spanish demonstrating statistical significance. When using the least educated (<9^{th} grade, OR=1) as the reference group, all other groups of participants , except those reporting “some college” (OR=.352, 95%CI=.109-1.136) were more likely to be diagnosed with breast cancer as follows: Some high school (OR=1.138, 95% CI=.689-1.881), High school graduate or equivalent (OR=1.120, 95% CI=.714-1.759), and Unknown (OR=1.110, 95% CI= .312-3.950). Among the 35 Health districts, only four (Cumberland Plateau, Eastern Shore, Lenowisco and Mount Rogers) were significantly less likely to be diagnosed with breast cancer than those in the reference district, Fairfax. Appendix L provides the Omnibus Test of Model Coefficients, Model Summary, Hosmer and Lemeshow Test and Contingency Table, and Classification Table.

Table 4.3 RQ1 Breast cancer diagnosis (age continuous)

	Crude OR	95% C.I. Lower	95% C.I. Upper	Adjusted OR	95% C.I. Lower	95% C.I. Upper
Race						
White						
Black	1.064	0.939	1.206	0.826	0.640	1.065
American Indian/Alaska Native	0.978	0.432	2.215	0.600	0.081	4.441
Asian	0.570	0.392	0.830	0.843	0.373	1.902
Pacific Islander/Native Hawaiian	3.891	0.888	17.052	5.369	1.116	25.831
Unknown	0.658	0.473	0.916	1.051	0.566	1.952
Age						
Continuous	1.011	1.001	1.021	1.050	1.030	1.070
Education						
<9th grade						
Some high school	1.123	0.712	1.771	1.138	0.689	1.881
High school graduate or equivalent	1.092	0.731	1.630	1.120	0.714	1.759
Some college or higher	1.344	0.893	2.024	0.352	0.109	1.136
Unknown	1.899	1.042	3.459	1.110	0.312	3.950
Income						
200% FPL	0.789	0.498	1.251	1.243	0.685	2.258
150% FPL	1.095	0.927	1.294	0.906	0.676	0.121
100% FPL						
Language						
English						
Spanish	0.432	0.292	0.639	0.325	0.154	0.739
Other/IndoEuropean	1.238	0.633	2.419	1.858	0.695	4.966
Asian/Pacific Islanders	0.327	0.189	0.568	0.352	0.109	1.136
Other	1.519	0.775	2.979	1.110	0.312	3.950
Prior mammo						
No						
Yes	0.758	0.653	0.879	0.724	0.539	0.973
Unknown	1.046	0.786	1.393	1.328	0.847	2.082

p=≤.05

DV: Breast cancer (Yes=1, No=0)

note: referent group italicized font

note: Health districts included in model; output in Appendix M

Recognizing that over 60% of the total sample did not report an educational level, it was important to compare the frequencies between those reporting an educational level and those not reporting an educational level. Chi-square tests results are presented in Table 4.4. The relationship between variables were significant with race X^2(5, N=34,942)=59.367, age X^2(1, N=34,492) =161.836, income X^2(2, N=32,668)=108.037, language X^2(4, N=34,885)=60.611 and prior mammogram X^2(2, N=34,786)=83.005. When the frequencies were evaluated by enrollment site (n=52) only six had education consistently reported in 100% of cases. At the other end of the spectrum, 14 sites had zero cases (n=1,708) with education reported. Interestingly, none of those 14 sites are currently serving as enrollment sites for the program. A complete accounting of enrollment site compliance is provided in Appendix N.

Table 4.4 Chi-square test on education

		Education Level Reported n(% within total sample)	No Education Level Reported n(% within total sample)	Sig.
Race	n=34,942			<.001
	White	7155 (20.5%)	12526 (35.8%)	
	Black	4309 (12.3%)	7513 (21.5%)	
	American Indian /Alaska Native	51 (0.1%)	134 (0.4%)	
	Asian	668 (1.9%)	845 (2.4%)	
	Pacific Islander/Native Hawaiian	13 (0.0%)	4 (0.0%)	
	Unknown	594 (1.7%)	1130 (3.2%)	
Age	n=34,492			<.001
	40-49	3811 (10.9%)	5230 (15.0%)	
	50+	8979 (25.7%)	16922 (48.4%)	
Income	n=32668			<.001
	200% FPL	380 (1.2%)	370 (1.1%)	
	150% FPL	1993(6.1%)	2948 (9.0%)	
	100% FPL	9574 (29.3%)	17403 (53.3%)	
Language	n=34,885			<.001
	English	11459 (32.8%)	20181 (57.9%)	
	Spanish	649 (1.9%)	1074 (3.1%)	
	Other/ IndoEuropean	80 (0.2%)	134 (0.4%)	
	Asian/Pacific Islanders	534 (1.5%)	598 (1.7%)	
	Other	53 (0.2%)	123 (0.4%)	
Prior mammo	n=34,786			<.001
	No	1807 (5.2%)	3927 (11.3%)	
	Yes	10286 (29.6%)	17292 (49.7%)	
	Unknown	607 (1.7%)	867 (2.5%)	

note: health districts and age (continuous) included in analysis; output in Appendix O

The same regression models were conducted among women with no education level reported and the results are presented in Table 4.5. Between models with age as a continuous variable, there were few differences noted with the exception of those speaking an Asian/Pacific Islander language (OR=.168, 95% CI=.054-.523) becoming statistically significant 85% less likely to be diagnosed with breast cancer compared to the English speaking reference group. Additionally, there were three different health districts (Chesterfield, Mount Rogers, Rappahannock) that now tested significantly less likely to be diagnosed than those in the Fairfax health district. Though some variables changed statistically, none of the variables changed direction when compared to those women reporting educational levels. With age as a categorical variable between models, race no longer tested significant among women for whom no education was reported. Women having a prior mammogram (OR=.741, 95% CI=.612-.897) and those speaking a language other than English (Spanish OR=.476, 95% CI=.256-.883;Asian/Pacific Islander OR=.180, 95% CI=.054-.525) were less likely to be diagnosed compared to the referent group. Among women with no education reported, three health districts (Chesterfield, Mount Rogers, Prince William) were significantly less likely than those in Fairfax to be diagnosed with breast cancer whereas Cumberland Plateau, Eastern Shore, Lenowisco and Mount Rogers health districts had tested significant among those with education reported. Only the 40-49 year old age (OR=1.241, 95% CI=1.041-1.479) variable changed direction when compared to women with education reported, becoming 1.241 times more likely than the 50+ group to be diagnosed. A complete summary of statistical output for this analysis, with age as a categorical variable, is provided in Appendix P.

Table 4.5 RQ1-Breast Cancer diagnosis among women with no education reported (age continuous)

N=20,165		Crude OR	95% C.I. Lower	95% C.I. Upper	Adjusted OR	95% C.I. Lower	95% C.I. Upper
Race							
	White						
	Black	1.055	0.907	1.228	0.975	0.806	1.179
	American Indian/ Alaska Native	0.830	0.305	2.254	0.732	0.231	2.324
	Asian/PI/NH	0.551	0.338	0.899	1.136	0.593	2.176
	Unknown	0.535	0.347	0.825	0.658	0.391	1.108
Age							
	Continuous	0.992	0.981	1.004	0.992	0.980	1.004
Income							
	200% FPL	0.565	0.266	1.200	0.611	0.287	1.301
	150% FPL	1.201	0.980	1.472	0.120	0.974	1.487
	100% FPL						
Language							
	English						
	Spanish	0.373	0.223	0.624	0.473	0.255	0.878
	Other/ IndoEuropean	1.020	0.416	2.499	1.165	0.453	2.999
	Asian/Pacific Islanders	0.267	0.119	0.598	0.168	0.054	0.523
	Other	1.588	0.738	3.416	1.329	0.508	3.481
Prior mammo							
	No						
	Yes	0.754	0.633	0.898	0.729	0.602	0.883
	Unknown	0.760	0.509	1.135	0.715	0.459	1.113

DV: breast cancer (Yes=1, No=0)

note: referent group italicized font

note: Health districts included in model; output in Appendix Q

note: *Pseudo R2*: Cox and Snell=.005; Naglekerke=.021

-2Log likelihood 5844.136, df=47

Research question two (breast cancer stage)

For the second research question, the same process was followed to build the logistic models with a change only in the dichotomous dependent variable, breast cancer stage (Stage

0/Invasive). A sub sample (n=1050), comprised of all women diagnosed with breast cancer, was available for analysis. With this reduced sample size, the race, language and health district categories were collapsed to provide sufficient power for analysis. Education was removed as an independent variable with severe underrepresentation (n=6) in the final analysis. A summary of the revised variable coding is presented in Table 4.6, along with the logistic regression results. Once again, a second regression model using age as a categorical variable was employed and those results are presented in Table 4.7.

Among those diagnosed with breast cancer, logistic regression was employed to predict the probability that a participant would be diagnosed with invasive compared to Stage 0, non-invasive breast cancer. Employing a .05 criterion of statistical significance, prior mammogram, income & geographic region had significant partial effects. Evaluating odds-ratios in the first model, for each one year increase in age (OR=1.001, 95% CI=.978-1.025) women 1.001 times more likely to be diagnosed with invasive breast cancer. The odds-ratio for race indicates that when holding all other variables constant, Black women (OR=1.151, 95% CI=.824-1.608) and other (OR=1.252, 95% CI= .559-2.805) women are 1.151 and 1.252 times more likely to be diagnosed with invasive breast cancer than the referent group (White, OR=1), respectively. Using the Central region as a reference category (OR=1), women residing in the Northwest (OR=2.138, 95% CI=1.149, 3.978), Southwest (OR=1.932, 95% CI= 1.275-2.926), and Southeast (OR=1.402, 95% CI=.976-2.013) regions demonstrate a higher likelihood of being diagnosed with invasive breast cancer. Women in the Northern region (OR=.933, 95% CI=.503-1.729) are seven percent less likely than those in the Central region to be diagnosed with invasive breast cancer. Women speaking a language other than English (OR=.600, 95% CI=.248-1.448) were 1.667 times less likely to be diagnosed with invasive breast cancer. The women in the income reference category, 100% FPL (OR=1) are more likely than those in the 200% FPL (OR=.320, 95% CI=.126-.809) to have an invasive breast cancer diagnosis while the 150% FPL (OR=1.213, 95% CI=.813-1.811) are 1.213 times more likely than the reference group. In a second model, with age as a categorical variable, the 40-49 year old age group (OR=.968, 95% CI=.696-1.348) was found three percent less likely to be diagnosed with invasive breast cancer compared to the 50+ (OR=1) referent age group. With no significant change among the other independent variables, compared to the first model with age as a continuous variable, results are presented in Table 4.7 but not discussed separately. Appendix R provides the Omnibus Test of Model Coefficients, Model Summary, Hosmer and Lemeshow Test and Contingency Table, and Classification Table for both models.

Table 4.6
RQ2 Breast cancer stage (age continuous)

			95% C.I.			95% C.I.	
		Crude OR	Lower	Upper	Adjusted OR	Lower	Upper
Age							
	continuous	.998	0.976	1.020	1.001	0.978	1.025
Race							
	White						
	Black	.972	0.730	1.293	1.151	0.824	1.608
	All others	.680	0.405	1.140	1.252	0.559	2.805
Language							
	English						
	Non-English	.552	0.317	0.962	0.600	0.248	1.448
Health District							
	Central						
	*Northwest	2.437	1.339	4.438	2.138	1.149	3.978
	Northern	.919	0.538	1.568	0.933	0.503	1.729
	*Southwest	2.004	1.366	2.939	1.932	1.275	2.926
	Southeast	1.522	1.092	2.121	1.402	0.976	2.013
Income							
	*200% FPL	.298	0.120	0.743	0.320	0.126	0.809
	150% FPL	1.093	0.743	1.608	1.213	0.813	1.811
	100% FPL						
Prior Mammogram							
	No						
	*Yes	.495	0.336	0.728	0.448	0.295	0.681
	*Unknown	.451	0.235	0.868	0.426	0.212	0.858

DV: Stage 0=0, Invasive=1

Note: *Pseudo* R^2 Cox & Snell= .038; Nagelkerke= .056

-2Log likelihood 1143.453, df=12

*$p \leq .05$

Table 4.7
RQ2 Breast cancer stage (age continuous)

		Crude OR	95% C.I. Lower	95% C.I. Upper	Adjusted OR	95% C.I. Lower	95% C.I. Upper
Age							
	40-49yo	1.020	0.751	1.386	0.968	0.696	1.348
	50+						
Race							
	White						
	Black	.972	0.730	1.293	1.151	0.824	1.606
	All others	.680	0.405	1.140	1.254	0.560	2.809
Language							
	English						
	Non-English	.552	0.317	0.962	0.599	0.248	1.446
Health District							
	Central						
	*Northwest	2.437	1.339	4.438	2.140	1.15	3.98
	Northern	.919	0.538	1.568	0.934	0.504	1.731
	*Southwest	2.004	1.366	2.939	1.929	1.274	2.923
	Southeast	1.522	1.092	2.121	1.403	0.977	2.014
Income							
	*200% FPL	.298	0.120	0.743	0.319	0.126	0.808
	150% FPL	1.093	0.743	1.608	1.214	0.814	1.812
	100% FPL						
Prior Mammogram							
	No						
	*Yes	.495	0.336	0.728	0.446	0.293	0.68
	*Unknown	.451	0.235	0.868	0.424	0.210	0.855

DV: Stage 0=0, Invasive=1

Note: *Pseudo* R^2 Cox & Snell= .038; Nagelkerke= .056

-2Log likelihood 1143.427, df=12

*$p \leq .05$

Research question three (source of information)

For the third research question, while the focus shifts to sociodemographic determinants influencing the source of health information, the statistical procedures were largely the same. Binary logistic regression, with the dichotomous dependent variable, source of information (Provider/Non-provider) was executed and the results are presented. To clarify, in this study "provider" includes not only physicians but also nurses, health departments and clinics while "non-provider" may include community health workers, media sources, health fairs, family and friends. A sample (n=26,626) was used in the regression model analysis. Through univariate and chi-square analysis the independent variable, education, was not found to be significant and was excluded from the analysis. The iterative process of model-fitting the data, an improvement in the model's ability to correct classify from 50% to 60% of the time was realized.

Using a .05 level of statistical significance, all variables tested (age, income, geographic region, race and language) had significant partial effects. Those 40-49 (OR=.872, 95% CI= .823-.924) were 13% less likely than those 50+ (OR=1) to report having heard about the EWL program from a provider. Interpreting the odds ratios reported in Table 4.8 for the regression model using the continuous age variable, age (OR=1.007, 95%CI=1.003-1.011) was found significant. That is, for every one year increase in age, participants were 1.007 times more likely to use a provider as their source of information for the EWL program. Using 100% FPL (OR=1) as the reference category, those in the 200% FPL (OR=1.535, 95% CI=1.284-1.834) group were found to be 1.5 times more likely to be referred by a provider. The 150% FPL (OR=.935, 95% CI=.871-1008) were only seven percent less likely than the lowest income group to have a provider refer them to the EWL program. Of the 34 health districts assessed against the referent, all were found to be up to 15 times more likely than the reference health district (Fairfax) to report a provider referral with 32 of the 34 found to be statistically significant at the .05 criterion. Another statistically significant finding was those in the Black (OR=1.118, 95% CI= 1.049, 1.191) race category were 1.118 times more likely than Whites (OR=1) to be referred by a health care provider. American Indian/Alaska Native (OR=.778, 95% CI= .555-1.099) and Asian (OR=.885, 95% CI=.692-1.131) race categories were 12-22% less likely to be referred by a provider than the referent group while Pacific Islander/Native Hawaiian (OR=1.267, 95% CI=.430-3.731) and all Other (OR=1.022, 95% CI= .881-1.185) categories were more likely than Whites to be referred by a provider. Using those that speak English (OR=1) as the reference group, Spanish (OR=1.088, 95% CI= .926-1.277), Other/IndoEuropean (OR=1.019, 95% CI= .722-1.440) and All others (OR=1.114, 95% CI= .752-1.649) were found to be more likely to hear about the EWL program from a provider. Those who reported speaking an Asian/PI (OR= .540, 95% CI= .392-.744) language were found significantly less likely to be referred to the program by a provider. That is, this group is more likely to have non-provider serve as the source of referral. Appendix U provides the Omnibus Test of Model Coefficients, Model Summary, Hosmer and Lemeshow Test and Contingency Table, and Classification Table for both models.

Table 4.8 RQ3 Source of Information

N=26,626

		Crude	95% CI		Adjusted	95% CI	
		OR	Lower	Upper	OR	Lower	Upper
Age	*continuous	1.005	1.001	1.008	1.007	1.003	1.011
	*40-49	.894	.848	.943	.872	.823	.924
	50+						
Race							
	White						
	*Black	1.096	1.043	1.152	1.118	1.049	1.191
	American Indian/ Alaska Native	.778	.567	1.066	0.778	0.55	1.099
	Asian	.265	.231	.303	.885	.692	1.131
	Pacific Islander/ Native Hawaiian	1.159	.420	3.198	1.267	.430	3.731
	Unknown	.773	.692	.864	1.022	.881	1.185
Language							
	English						
	Spanish	.597	.535	.666	1.088	.926	1.277
	Other/ IndoEuropean	.580	.430	.783	1.019	.722	1.440
	*Asian/ Pacific Islanders	.165	.138	.196	.540	.392	.744
	Other	.544	.389	.760	1.114	.752	1.649
Income							
	*200% FPL	1.492	1.264	1.762	1.535	1.284	1.834
	150% FPL	.938	.878	1.003	0.935	0.871	1.008
	100% FPL						

DV: Source of Information (Non-Provider=0, Provider=1)

Health districts included in analysis-output in Appendix S

Age (categorical) included in separate model-Appendix T

Note: *Pseudo* R^2 Cox & Snell= .074; Nagelkerke= .099

CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter presents a summary of results for each of the analyses described in Chapter 4, a detailed discussion for each research question, limitations, implications for future practice and policy followed by study conclusions.

Summary of results

This section provides a synopsis of the results presented in the previous chapter. The analyses were designed to answer the following research questions about Virginia women utilizing the *Every Woman's Life* program.

RQ1. What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and prior mammography and cancer diagnosis among women 40-64 years of age utilizing *EWL* services?

RQ2. What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and prior mammography and cancer stage at the time of diagnosis among women 40-64 years of age utilizing *EWL* services?

RQ3. What is the association between socio-demographic determinants (race, age, income, education, language and geographic location) and source of information among women 40-64 years of age utilizing *EWL* services?

The purpose of this study was to explore and identify factors that may impact participants' breast cancer diagnoses, stage at the time of diagnosis and source of information to the *Every*

Woman's Life program. Any findings, significant or otherwise, should be interpreted with caution and not generalized beyond Virginia women eligible for EWL breast cancer screening services. This research provided a unique opportunity to explore data not publicly available.

A summary of findings is presented in Table 5.1. Highlights of the statistically significant findings include:

- The likelihood of being diagnosed with breast cancer increases with age for the subset of women who reported an educational level
- Those with a prior mammogram were less likely to be diagnosed with breast cancer than those reporting no prior mammogram for the entire sample
- Those with a prior mammogram were less likely to be diagnosed with invasive breast cancer than those reporting no prior mammogram
- The "highest" income tier (200% FPL) were less likely to have invasive breast cancer than the "lowest" income tier (100% FPL)
- The 200% FPL group were more likely to be referred to EWL by a provider than the 100% FPL group
- The 40-49 age group were less likely than the 50+ to be diagnosed with breast cancer among those reporting education level; more likely among those not reporting an education level
- Women reporting their race as "Black" were more likely to hear about the EWL program by a provider than their white counterparts

Table 5.1
Summary of study findings

Variable	Breast Cancer (RQ1)	Breast Cancer Stage (RQ2)	Source of information (RQ3)
Age	**Sig.**	NS	**Sig.**
Race	**Sig.**	NS	**Sig.**
Education	NS	*	*
Language	**Sig.**	NS	**Sig.**
Income	NS	**Sig.**	**Sig.**
Geographic locale	**Sig.**	**Sig.**	**Sig.**
Prior mammogram	**Sig.**	**Sig.**	*

Sig.= statistically significant $p \leq .05$
NS = not significant
* = excluded from regression model

Prior to discussing individual research questions, a review of the EWL database reveals a sample representative and reflective of the general population of Virginia, as provided by the US Census Bureau. The comparison is presented in Table 5.2. As expected in a sample of low income women, the highest education attained is lower (73.3%) compared to a statewide sample where 87.5% reported having graduated high school. Education is often used as an indicator of poverty as it is directly related to income and employment (Council on Virginia's Future, 2015). Education was not found to be significant in any of the analyses in this study. However, the highest income group was found significantly less likely to be associated with an invasive breast cancer diagnosis compared to the lowest income group but more likely to be referred to the EWL program by a provider.

Table 5.2
Sample demographics compared to Virginia

	Percentage of Sample[a]	Virginia [b]
Race		
White	56.30%	70.50%
Black/African American	33.80%	19.70%
American Indian/Alaska Native	0.50%	0.50%
Asian	4.30%	6.30%
Pacific Islander/Native Hawaiian	<<0.1%	0.10%
Other	4.90%	2.80%
Education		
High school graduate or higher	*73.3%	87.50%
Language		
Language other than English spoken at home	9.30%	14.90%

[a] Sample N=34,942

* Available sample n=13,179

[b] Source U.S. Census Bureau: State and County QuickFacts, 2014

Breast cancer diagnosis

Analysis for research question one focused on those factors predictive of a breast cancer diagnosis. In an effort to build the best model for the given data, univariate analysis was performed to assess the independent variables significantly associated with the dependent variable, breast cancer diagnosis. Further, correlations were calculated for all the independent variables to check for collinearity and aid in decision making around the model. The resultant model, using age as a continuous variable, indicated a high percentage (97%) of properly classifying each variable, indicating confidence in the fit of the model. Consistent with the literature, significant findings of logistic regression analysis included an increased likelihood of a breast cancer diagnosis with each one year increase in age. However, the younger 40-49 (OR=1.241, 95% CI=1.041-1.479) were more likely to be diagnosed with breast cancer compared to the 50+ reference group among those not reporting an educational level. Outside of the EWL targeted priority population, it is possible those 40-49 year old women receiving services reported a strong family history or symptoms when referred, though this information is not available and is only speculative. Those having reported a prior mammogram (OR= .724, 95% CI=.539-.973) were found less likely to be diagnosed with breast cancer than those with no prior mammogram (OR=1) across the entire sample. With 17 cases in the sample, Native Hawaiian/Pacific Islander (OR=5.369, 95% CI= 1.116-25.831) were found significantly more likely to be diagnosed with breast cancer when compared to the White (OR=1) racial category. With this small sample, it is not unexpected to have a large confidence interval and the results should be interpreted carefully. Statistical resources (Field, 2009) promote caution with regard to the use and interpretation of R^2 in logistic regression. However, the *pseudo* R^2 measures, Cox & Snell and Naglekerke, provide at least a gauge of how well the model fits the data. The amount of variance in the outcome accounted for by the independent variables was .013, as measured by Cox & Snell *pseudo* R^2. Other measures of model fit were observed throughout the process, including the -2LL (-2*log likelihood) which improved (decreased numerically) as independent variables were added to the model.

Within the framework of the socioecological model, mammograms are provided to the individual (intrapersonal level) by the EWL program (organizational level) and their coalition partners (community level) and funded through the NBCCEDP (policy level). Through an ecological perspective, there is focus on the system rather than the individual. In the case of the EWL, the system expands well beyond the individual though it requires individual action to acquire a screening mammogram. For instance, areas in the Commonwealth of Virginia with the highest incidence of breast cancer are available publicly and are presented in Figure 5.1 (NCI, 2015). Comparing the areas of highest incidence, denoted in red on the map in Figure 5.1, to the placement of EWL provider sites (Figure 5.2) it is observed that large geographic areas are served by a single enrollment site (organizational level). It is only with the enlistment of community partners to provide clinical services (community level) that the need can be met. The results from this research add to the body of knowledge and inform EWL program officials with regard to determinants influential in breast cancer diagnosis, breast cancer stage and source of program information, using data spanning 15 years.

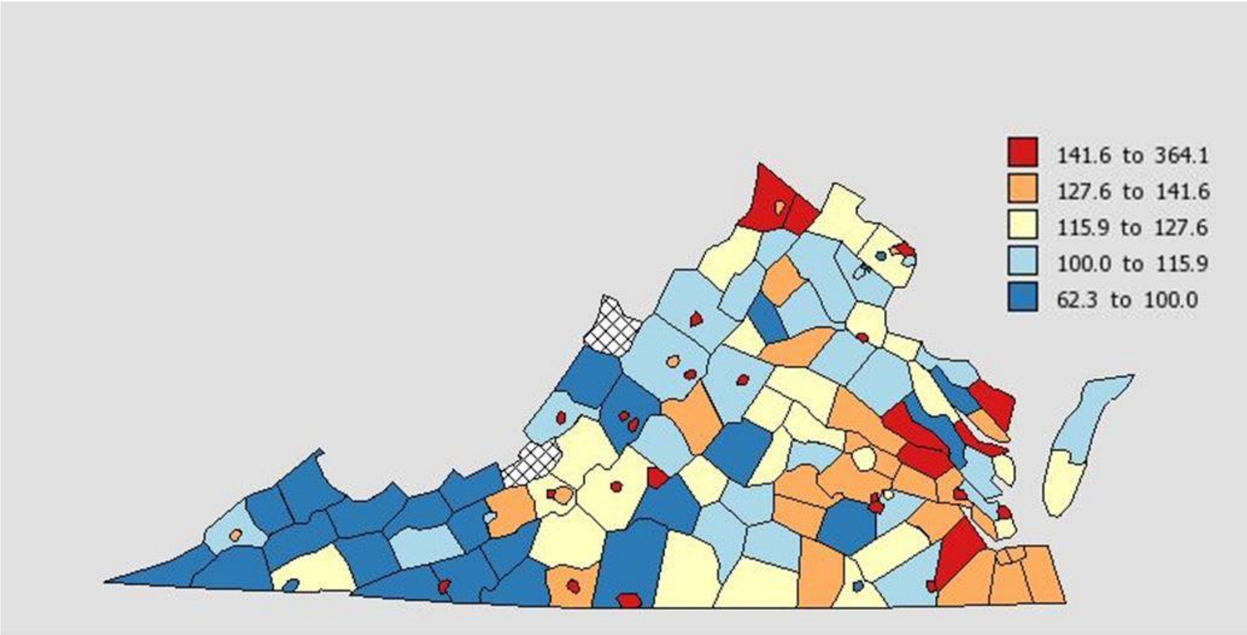


Figure 5.1 2008-2012, Virginia breast cancer annual incidence rates per 100,000 (age-adjusted)
Source: State Cancer Profiles, 2015

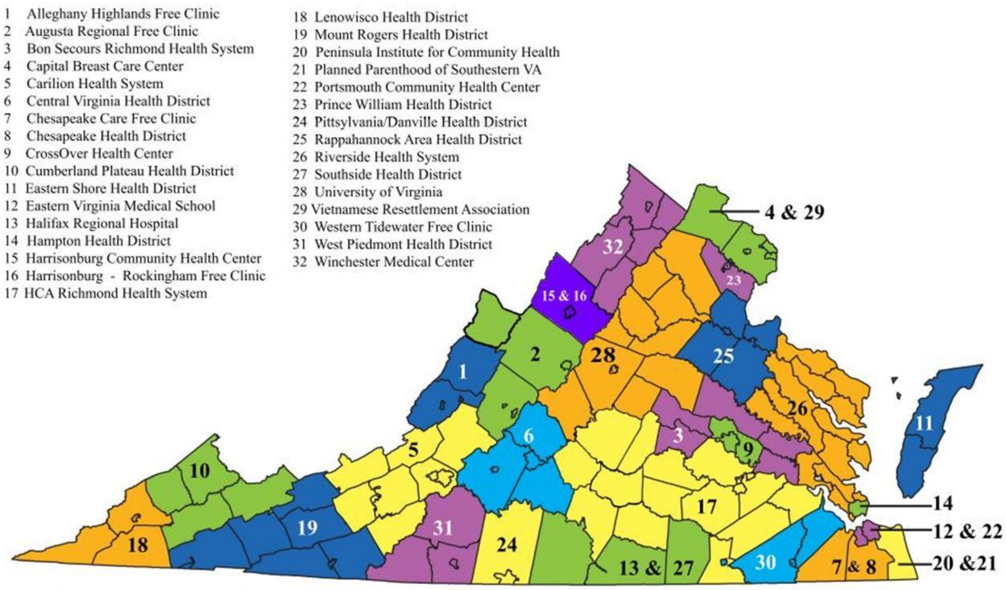


Figure 5.2 Every Woman's Life Provider Sites (2013-2014)
Source: Virginia Department of Health

Breast cancer stage

Research question two focused on identifying factors which influence the stage at which breast cancer is detected and diagnosed. As discussed in Chapter 3, without complete staging information, an alternate staging stratification system was adopted for the analysis. Stage 0 includes DCIS and LCIS (both considered non-invasive) while "invasive" is a broad term encompassing cancers that would be considered "early stage" (DCIS, Stage I, IA, IIB and IIIA) by the National Cancer Institute, along with more advanced staged cancers. Early stage is an important prognostic indicator for healthcare professionals when considering appropriate treatment for breast cancer and impacts long term survival (Soerjomataram et al., 2008).

Bivariate analysis was conducted to test significance associated with breast cancer stage. Education was not a significantly associated with the dependent variable. Additionally, education was a limiting variable due to missing cases within this smaller sample (n=1143) made up of only those diagnosed with breast cancer. For these reasons, education was excluded from the model in research question two. With the smaller sample for analysis other variables were similarly evaluated and stratification levels were collapsed to assure adequate cases. The 35 VDH health districts were collapsed into their respective five EWL regions (Central, Northwest, Northern, Southwest, Southeast). Both the race (White, Black/African American, Other) and language (English, Non-English) variables were adjusted at achieve required representation per cell. The percent of correct classification was moderately high (75%) indicating reasonable confidence in the model. The logistic regression demonstrated that preventive health behaviors, like mammograms, provide improved health outcomes as if often cited in the literature and is the essential message when promoting breast cancer screening programs (Gornick, Eggers & Riley, 2004). In this sample, having a prior mammogram was found to be a protective factor for invasive breast cancer. That is, those with no prior mammogram (OR=1) were more likely to have an invasive cancer than those with a mammogram (OR=.448, 95% CI= .295-.681) or even those with an unknown screening history (OR=.426, 95% CI= .212-.858). With the Central region as a reference, both the NW (OR=2.138, 95% CI=1.149-3.978) and SW (OR= 1.932, 95% CI= 1.275-2.926) regions were significantly more likely to be diagnosed with invasive, rather than Stage 0. With these significant findings, a broad overview of the entire sample was explored by region (Appendix I). In general, participants in the NW and SW regions had less education, a higher percentage of women with no prior mammogram, a higher average age, a higher percentage in the White racial category and in the NW, a language other than English was spoken in 11% of the region. Also notable was that within the Northern region English was the language spoken everyday in less than 50% of those in the sample, with 23% Spanish and another 26% reporting an Asian language. Among the three income levels, the participants in the highest income 200% FPL group were almost 70% less likely to be diagnosed with invasive breast cancer than those in the lowest income bracket, 100% FPL. The results do provide evidence to support the concept that incremental poverty produces incrementally poor health outcomes (Clegg et al., 2009; Sapolsky, 2005). Consistent with the literature that racial/ethnic minorities are more likely to have advanced stage cancer at the time of diagnosis, the regression analysis showed both Blacks/African American (OR=1.151, 95% CI=.824-1.608) and all other non-White (OR=1.252, 95% CI=.559-2.805) racial categories more likely to be diagnosed with invasive breast cancer compared to the White (OR=1) referent group (Henley, King, German, Richardson & Plescia, 2010).

Source of information

Research question three moves the emphasis from clinical outcome to source of health information about the EWL program. Provider recommendation saturates the health education literature as the most important factor in preventive health behaviors, like screening mammography (Schueler, 2008; Nuno, 2011; Young, 2011). Provider, which in this study may include physicians as well as family and friends, “sits” at the interpersonal level within the socioecological model. Non-provider sources of health information range from self (individual level), health departments (organizational level) and health fairs (community levels) and represent over 50% (51.2%, actual) of the responses in this sample. The regression analysis demonstrated the younger age group, 40-49 (OR=.872, 95% CI= .823-.924) were 13% less likely than 50+ category to hear about the EWL program from a provider. Likewise, those speaking Asian/Pacific Islander (OR= .540, 95% CI= .392-.744) languages were 1.85 times less likely than those speaking English to use providers as sources of health information, indicative that these women may prefer alternate sources of health information. The results for the tiered income levels (200% FPL, 150% FPL, 100% FPL) reinforce health indicators worsen with decreasing wealth, even among the lowest tiers of income (Chu, Miller & Springfield, 2007). In the third research question, the logistic regression analysis found the highest income echelon (200% FPL) was 1.5 times more likely to hear about the EWL program from a provider compared to the 100% FPL group.

Limitations

The first limitation addresses the presence of bias. Aside from cancer staging information, demographic and health behavior information was self-reported by the participant using the Client Eligibility Form (Appendix E). Self-reported measures produce measurement error as other factors may influence the responses provided by the participant (Field, 2009). Within this sample, missing data (non-response bias) became problematic for the regression model with regard to education and smoking variables. Social desirability bias may be present with these variables as well.

The second limitation addresses incomplete or missing data, in which the sample analyzed may not represent the full data set. AJCC and summary staging information, normally introduced into the EWL database when synchronized with the Virginia Cancer Registry database, was available for 40% (460/1143) of those diagnosed with breast cancer. This limited meaningful separation between “early” and “not early” stages of breast cancer in the sample, as was originally proposed for the study. Instead, separation was made on the basis of invasiveness. Ductal carcinoma in situ (DCIS) and lobular carcinoma in situ (LCIS) represent Stage 0 breast cancer or breast “condition” in the case of LCIS while all other cancers, were included in the invasive level. Within the invasive category there may exist cancers with a wide range of prognostic indicators, limiting the meaningful interpretation of the regression analysis. Additionally, the “unknown” status for race, education and mammogram presented some ambiguity as the researcher was unclear whether the “unknown” status was entered by the EWL data entry personnel for cases in which the client eligibility form was left blank or if the participants actually entered “unknown” as a response.

Third, as with much cancer research, the women studied may have unknown or undisclosed breast cancer risk factors which may have more influence than the variables presented in this study. These may include both non-modifiable factors, such as breast cancer family history, as well as life choices such as diet and exercise.

A fourth limitation addresses the researcher’s decision to exclude a woman’s “intent to quit smoking” among smokers as a preventive health behavior due to missing data within the subset of women diagnosed with cancer. In retrospect, the participants’ non-smoking status would have been a more suitable proxy to serve as a preventive health behavior.

Finally, the last limitation is the restricted generalizability of the study. These research results and interpretations must be confined to women who are eligible for EWL services.

Implications for research/practice/policy

To extend the socioecological model, areas for future research at the interpersonal level may include a more in-depth analysis of the sources of information for the EWL program commonly employed among low income women in Virginia, given that over 50% were referred by a source other than “provider” in this sample.

Recommendations for the EWL program at the organizational level include a continued emphasis to recruit and promote screening mammography, especially among those with no screening history. Within the sample, 79% of participants reported a prior mammogram which surpasses statewide (78%) and national (75%) breast cancer screening rates (BRFSS, 2010). This study’s findings reinforce the premise that those with no prior mammogram are the most likely to be diagnosed with cancer and are more likely to be diagnosed with a more advanced stage of cancer at the time of diagnosis. With over 55,000 duplicate cases removed from this analysis, representing women with more than one mammogram over the 15 year timeframe, program officials should continue to target those women with no history of a prior mammogram and those without a mammogram within the past two years.

At the community level, EWL enrollment sites and coalition partners are recommended to have a heightened readiness to address linguistic, cultural and educational differences among the increasingly diverse communities served by the program. Appendices V and W provide demographic profiles for the sample stratified by health districts and EWL enrollment sites, respectively. To illustrate, the Alexandria health district with 144 women represented in the sample, has the lowest average income and lowest educational level attainment while the Virginia Beach health district (n=560) has the highest average education level. The Thomas Jefferson (n=1300) health district has the highest average income reported. The most racially and linguistically diverse health district is the Fairfax (n=1702) health district. Tailored health promotion messages designed at the health district level are appropriate.

At a policy level, results of this study reinforce that health disparities persist across all socioeconomic levels, even among the poorest Virginians. Despite the passage of the Affordable Care Act (ACA) and its emphasis on preventive care and personalized medicine for all, low income women in Virginia will continue to need federally funded programs such as EWL since Virginia has not expanded Medicaid coverage to include low income adults (CMS, 2015). Additionally, there is no state legislation neither approved nor pending to require cultural competency training for state health professionals to assure compliance with National Cultural and Linguistically Appropriate Services in Health and Health Care (CLAS) standards (Office of

Minority Health, 2015). Advocacy efforts to support such legislation would strengthen and equip EWL's network of clinical service providers to better serve its participants.

Conclusions

This research provided an investigation into factors influencing breast cancer screening, diagnosis, stage at the time of diagnosis and sources of health information in a sample of low income women 40-64 years of age. The results of the study confirmed long standing breast cancer risk factors, like the increasing incidence of breast cancer with increasing age and that those with a prior mammogram are diagnosed at earlier stages of breast cancer. Blacks/African American women were high utilizers of the program, comprising 33.8% of the sample while only representing 19.7% of the population in Virginia (US Census, 2014). This is in alignment with 2014 CDC data indicating Black/African American women are screened at higher rates (73.2%) than other racial groups White (72.8%) American Indian/Alaska Native (68.2%), as presented in Figure 5.3.

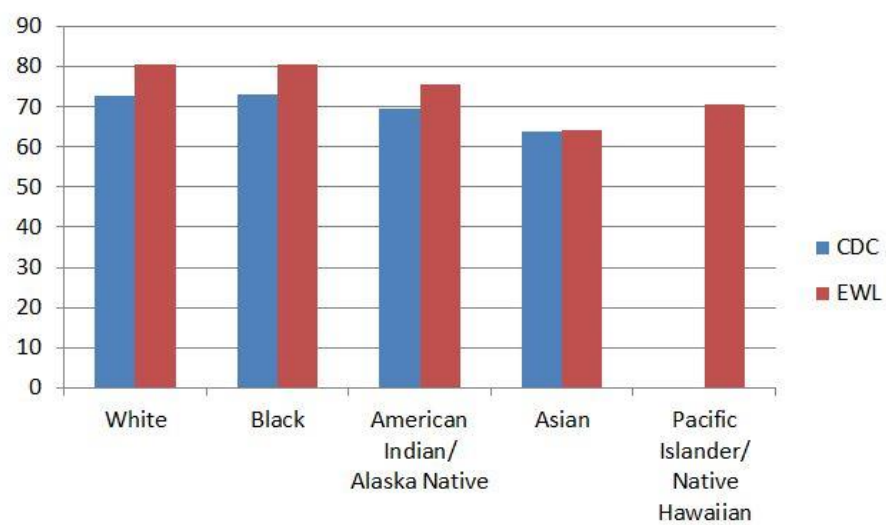


Figure 5.3 Comparative mammography screening rates
Source: Centers for Disease Control and Prevention, 2014
* No data were supplied for Pacific Islander/Native Hawaiian

This research aimed to provide a baseline of EWL-specific information for policymakers, program officials and practitioners alike. This research proves to be both timely and useful as breast cancer screening guidelines are once again in the media headlines, continuing the controversy regarding the appropriate age to begin mammographic screening. Within this relatively homogenous low-income sample of women, analyses show breast cancer and preventive health disparities persist. Specifically, the lowest income tier (100% FPL) was more likely to have invasive breast cancers diagnosed than the top tier (200% FPL). Again, those with the most relative "wealth" were more likely to use a health provider as the source of information about the EWL program. Finally, geographic regions in which demographic characteristics include women with less education, a lower percentage of prior mammograms and a language, other than English spoken in the house were more likely to be diagnosed with invasive breast cancer. Continued, regular evaluation of the program is recommended to accommodate new influences such as changes in population demographics or community partners as well as regional, state and federal policies that may impact EWL services.

REFERENCE LIST

Adams, K.E., Breen, N. & Joski, P.J. (2007). Impact of the national breast and cervical cancer early detection program on mammography and pap test utilization among white,Hispanic, and African American women: 1996–2000. *Cancer (0008543X), 109*(0), 348-358.

Allen, J. D., Sorensen, G. G., Stoddard, A. M., Colditz, G. G., Peterson, K. K., Allen, J. D., & ... Peterson, K. K. (1998). Measure of Self-Efficacy in Relation to Mammography. *Health Education and Behavior*, *25*, 474-488.

Allison, P. (2012) When Can You Safely Ignore Multicollinearity? Retrieved from: http://statisticalhorizons.com/multicollinearity

American Cancer Society. (2015) acAmerican Cancer Society guidelines for the early detection of cancer. Retrieved from http://www.cancer.org

Agency for Healthcare Research and Quality. (2009). *National Healthcare Disparities Report.*

Appalachian Regional Commission. (2013). The Appalachian Region. Retrieved from: http://www.arc.gov on November 15, 2013.

Aschengrau, A. & Seage, G. (2008). 2nd ed. Essentials in Epidemiology in Public Health. Sudbury, MA: Jones and Bartlett.

Bandura, A. (1977). *Self-efficacy: Toward a unifying theory of behavior change*. Psychological Review, *84*, 191-215.

Beaulieu, M., Beland, F., Roy, D., Farlardeau, M., and Hebert, G. (1996). Factors determining compliance with screening mammography. *Canadian Medical Association Journal*, *154*(9), 1335-1343.

Benard, V.B., Saraiya,M.S., Soman, A., Roland, K.B., Yabroff, K.R., and Miller, J. (2011). Cancer Screening Practices Among Physicians in the National Breast and Cervical Cancer Early Detection Program. *Journal of Women's Health, 20*(10), 1479-1484. doi: 10.1089jwh.2010.2530

Bishaw, Alemayehu and Jessica Semega, U.S. Census Bureau, American Community Survey Reports, ACS-09, Income, Earnings, and Poverty Data From the 2007 American Community Survey, U.S. Government Printing Office, Washington, DC, 2008.

Bradley, C.J., Given, C.W. & Roberts,C. (2002). Race, socioeconomic status, and breast cancer treatment and survival. *Journal of the National Cancer Institute*, *94* (7), 491-496.

Braveman, P. (2006). Health Disparities and Health Equities: Concept and measurement. *Annual Review of Public Health, 27*, 167-194. doi: 10.1146/annurev.publhealth.27.021405.102103.

Breast and Cervical Cancer Mortality Prevention Act of 1990. 101 P.L. 354. 104 Stat. 409. Enacted HR 4790. (1990).

Breast and Cervical Cancer Prevention and Treatment Act of 2000. 106 P.L.354. 114 Stat. 1381-1384. Enacted HR. 4386. (2000).

Bronfenbrenner, U. (1979). *The Ecology of Human Development: Experiments by Nature and Design*. Cambridge, MA: Harvard University Press.

Cardenas, V., Ajinkya, J., & Leger, D. (2011). *Fast Facts: Virginia's Growing Diversity*. Retrieved from http://www.americanprogress.org.

Centers for Disease Control and Prevention. (2013). *Moving Forward in an Era of Reform: New Directions for Cancer Screening.* Retrieved from http://www.cdc.gov/cancer/nbccedp/pdf/newdirections_screening.pdf

Centers for Disease Control and Prevention, *Behavioral Risk Factor Surveillance System History*. (2013). Retrieved from http://www.cdc.gov/brfss/about/about.brfss.htm

Centers for Disease Control and Prevention, Division of Cancer Prevention and Control. (2012). *NBCCEDP Program Guidance Manual.* Retrieved from http://www.cdc.gov.

Centers for Disease Control and Prevention. (2013). *NBCCEDP Screening Program Summary-Virginia.* Retrieved from http://www.cdc.gov/cancer/nbccedp/data/summaries/virginia.htm

Centers for Disease Control and Prevention. (2010). Vital Signs: Breast cancer screening among women aged 50-74 years -- United States, 2008. *MMWR: Morbidity & Mortality Weekly Report, 59*(26), 813-816.

Centers for Medicare & Medicaid Services. (2015) Retrieved from: http://www.medicaid.gov/medicaid-chip-program-information/by-state/virginia.html

Chu, Miller & Springfield. (2007). Measures of racial/ethnic health disparities in cancer mortality rates and the influence of socioeconomic status. *Journal of the National Medical Association, 99* (10): 1092-1104.

Clark, C., Baril, N., Achille, E., Foster, S., Johnson, N., Taylor-Clark, K., Gagne, J., Olukoya, O., Huisingh, C., Ommerborn, M., & Viswanath, K. (2014). Trust yet verify: Physicians as trusted sources of health information on HPV for black women in socioeconomically marginalized populations. *Progress in Community Health Partnerships: Research, Education, and Action*, *8*(2): 169-179. doi: 10.1353/cpr.2014.0019

Clegg, L., et al. (2009). Impact of socioeconomic status on cancer incidence and stage at diagnosis: selected findings from the surveillance, epidemiology, and end results: National Longitudinal Mortality Study. *Cancer Causes Control*, 20 *(4).* doi: 10.1007/s10552-008-9256-0.

Comprehensive Cancer Prevention and Control Program Report. (2012). Virginia Department of Health. Retrieved from: www.vdh.virginia.gov/ofhs/prevention/cpc/cccp.htm

Council on Virginia's Future. (2015). Virginia Performs. Retrieved from: http://vaperforms.virginia.gov/indicators/economy/personalIncome.php

Creswell, J.W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Cutilli, C. (2010). Seeking health information: what sources do your patients use?. *Orthopedic Nursing 29*(3): 214-219. doi: 10.1097/NOR.0b013e3181db5471

Daley, C., Filippi, M., James, A., Weir, M., Braiuca, S., Kaur, B., et al. (2012). American Indian community leader and provider views of needs and barriers to mammography. *Journal of Community Health, 37*(2), 307-315. doi: 10.1007/s10900-011-9446-7

Dutta-Bergman, M. (2003). Trusted Online Sources of Health Information: Differences in Demographics, Health Beliefs, and Health-Information Orientation. *Journal of Medical Internet Research, 5*(3): e21. doi: 10.2196/jmir.5.3.e21

Elkin, E. B., Atoria, C. L., Leoce, N., Bach, P. B., & Schrag, D. (2013). Changes in the availability of screening mammography, 2000-2010. *Cancer (0008543X)*, *119*(21), 3847-3853. doi:10.1002/cncr.28305

Elmore, J. & Kramer, B. (2014). Breast Cancer Screening: Toward Informed Decisions. *Journal of the American Medical Association, 311*(13), 1298-1299.

Escoffery, C. T., Kegler, M. C., Glanz, K., Graham, T. D., Blake, S. C., Shapiro, J. A., & ... Fernandez, M. E. (2012). Recruitment for the National Breast and Cervical Cancer Early Detection Program. *American Journal Of Preventive Medicine*, *42*(3), 235-241. doi:10.1016/j.amepre.2011.11.001

Ferrante, J. M., Balasubramanian, B. A., Hudson, S. V., & Crabtree, B. F. (2010). Principles of the patient-centered medical home and preventive services delivery. *Annals of Family Medicine, 8*(2), 108-116.

Field, A. (2009). *Discovering Statistics Using SPSS.* 3rd ed. Thousand Oaks, CA: Sage Publications.

Flores, Y.N., Davidson, P.L., Nakazono, T.T., Carreon, D.C., Mojica, C.M. & Bastani, R. (2013). Neighborhood socio-economic disadvantage and race/ethnicity as predictors of breast cancer stage at diagnosis. *BMC Public Health*, 13: 1061. doi: 10.1186/1471.

Golden, S.D., & Earp, J. (2012). Social Ecological Approaches to Individuals and Their Contexts: Twenty Years of *Health Education & Behavior* Health Promotion Interventions. *Health Education & Behavior,39*(3), 364-372. doi: 10.1177/109019811418634.

Gornick, M., Eggers,P., & Riley,G. (2004). Associations of Race, Education and Patterns of Prevention Service Use with Stage at Time of Diagnosis. *Health Services Research, 39*(5): 1403-1428. doi: 10.1111/j.1475-6773.2004.00296

Harper, S., Lynch, J., Meersman, S. C., Breen, N., Davis, W. W., & Reichman, M. C. (2009). Trends in area-socioeconomic and race-ethnic disparities in breast cancer incidence, stage at diagnosis, screening, mortality, and survival among women ages 50 years and over (1987-2005). *Cancer Epidemiology, Biomarkers & Prevention, 18*(1), 121-131.

Henley, S., King, J., German, R., Richardson, L., & Plescia, M. (2010). Centers for Disease Control and Prevention and Prevention. Surveillance of screening detected-cancers (colon and rectum; breast and cervix) United States 2004-2006. *MMWR Surveillance Summaries 2010: 59 (9)*:1-25.

Hoerger, T. J., Ekwueme, D. U., Miller, J. W., Uzunangelov, V., Hall, I. J., Segel, J., et al. (2011). Estimated effects of the national breast and cervical cancer early detection program on breast cancer mortality. *American Journal of Preventive Medicine, 40*(4), 397-404. doi: 10.1016/j.amepre.2010.12.017.

Hosmer, D., Lemeshow, S. & Sturdivant, R. (2013). 3rd ed. Applied Logistic Regression. Hoboken, NJ: John Wiley & Sons, Inc.

Howard, D., Ekwueme, D., Garnder, J., Tangka, F., Li, C., & Miller, J. (2010). The Impact of a National Program to Provide Free Mammograms to Low-Income, Uninsured Women on Breast Cancer Mortality Rates. *Cancer 116*(119), 4456-4462. Doi: 10.1002/cncr.25208

Hunt, A. (2015). A Researcher's Guide to Power Analysis. Retrieved from: https://rgs.usu.edu/irb/files/uploads/A_Researchers_Guide_to_Power_Analysis_USU.pdf

IOM (Institute of Medicine). 2011. *Clinical Preventive Services for Women: Closing the Gaps*. Washington, DC: The National Academies Press.

Joy, J.E., Penhoet, E.E., and Petitti, D.B., eds. (2005). Saving Women's Lives: Strategies for improving breast cancer detection and diagnosis. National Academies Press. Washington, D.C.

Kasl, S. and Cobb, S. (1966) Health and Illness Behavior. *Archives of Environmental Health,* 12(4): 531-541. Doi: 10.1080/00039896.1966.10664421

Kratzke, C., Wilson,S., & Vilchis, H. (2013). Reaching rural women: Breast cancer prevention information seeking behavior and interest in internet, cell phone, and text use. *Journal of Community Health,38*(1): 54-61. doi: 10.1007/210900-012-9579-3

Krieger, N. (2013). History, Biology, and Health Inequities: Emergent embodied phenotypes and the illustrative case of the breast cancer estrogen receptor. *American Journal of Public Health, 103*(1),p22-27. doi: 10.2105/AJPH.2012.300967.

Lantz, P.M., Weisman, C.S. and Itani, Z.(2003). A disease-specific Medicaid expansion for women: The breast and cervical cancer prevention and treatment act of 2000. *Women's Health, 13*, 70-92. doi: 10.1016/S1049

Lantz, P. M., Mujahid, M., Schwartz, K., Janz, N. K., Fagerlin, A., Salem, B., et al. (2006). The influence of race, ethnicity, and individual socioeconomic factors on breast cancer stage at diagnosis. *American Journal of Public Health, 96*(12), 2173-2178. doi: 10.2105/AJPH.2005.072132.

Lawson, H., Henson, R., Bobo, J., & Kaeser, M. (2000). Implementing Recommendations for the Early Detection of Breast and Cervical Cancer Among Low-Income Women. *Morbidity and Mortality Weekly Report.49*(RR-2).

Lemkau, J. & Grady, K. (1998). Impact of Family Physicians on Mammography Screening. *American Family Physician, 58*(4), 854-859.

Lieberman, L., Golden, S. D., & Earp, J. L. (2013). Structural Approaches to Health Promotion: What Do We Need to Know About Policy and Environmental Change? *Health Education & Behavior*, *40*(5), 520-525. doi: 10.1177/1090109113503342.

Maloney, N., Koch, M., Erb, D., Schneider, H., Goffman, T., Elkins, D. & Laronga, C. (2006). Impact of race on breast cancer in lower socioeconomic status women. *The Breast Journal, 12*(1), 58-62. doi: 10.1111/j.1075-122X.2006.00184.x.

Martin, N., & Wingfield, J. (2012). USPSTF screening recommendations for breast cancer: The potential impact on the african american community. *Journal of Health Care for the Poor & Underserved*, *23*(2), 91-97. doi: 10.1353/hpu.2012.0072.

McLeroy, K., Bibeau,D., Steckler,A. and Glanz,K. (1988) An Ecological Perspective on Health Promotion Programs. *Health Education Quarterly 15*(4): 351-377.

Miller, A., Wall, C., Baines, C., Sun, P., To, T. and Narod, S. (2014). Twenty five year follow-up for breast cancer incidence and mortality of the Canadian National Breast Screening Study: randomized screening trial. *BMJ* 348 doi: 10.1136/bmj.g366

Mittler, J., Martsolf, G., Telenko, S., & Scanlon, D. (2013). Making Sense of 'Consumer Engagement' Initiatives to Improve Health and Health Care: A Conceptual Framework to Guide Policy and Practice. *Milbank Quarterly*, *91*(1), 37-77. doi: 10.1111/milq.12002.

National Cancer Institute. (2015). State Cancer Profiles. Retrieved from: http://statecancerprofiles.cancer.gov/cgi-bin/quickprofiles/profile.pl?51&055

National Cancer Institute. (2015). Cancer of the Breast-SEER Stat Fact Sheet. Retrieved from: www.seer.cancer.gov/statfacts/html/breast.html

National Cancer Institute. (2014). Mammogram Fact Sheet, Retrieved from: www.cancer.gov/types/breast/mammograms-fact-sheet

National Prevention Council, National Prevention Strategy. (2010).*National Prevention Strategy*. Retrieved from: http://www.surgeongeneral.gov/initiatives/prevention/strategy/national-prevention-strategy-fact-sheet.pdf

National Research Council. *Speaking of Health: Assessing health communication strategies for diverse populations.*Washington, D.C. The National Academies Press, 2002.

Nelson, H., Tyne, K., Naik, A., Bougatsos, C., Chan, B., & Humphrey, L. (2009). Screening for breast cancer: An update for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*, 151: 727-737. doi: 10.7326/0003-4819-151-10-200911170-00009.

Nuno, T., Castle, P., Harris, R., Estrada, A. & Garcia, F. (2011). Breast and Cervical Cancer Screening Utilizaton Among Hispanic Women Living Near the United States-Mexico Border. *Journal of Women's Health 20*(5), 685-693. doi: 10.1089/jwh.2010.2205

Office of Minority Health. The National CLAS Standards. Retrieved from: http://minorityhealth.hhs.gov/omh/browse.aspx?lvl=2&lvlid=53

Oeffinger, K. et al. (2015) Breast Cancer Screening for Women at Average Risk 2015 Guideline Update From the American Cancer Society. Retrieved from: http://www.cancer.org/cancer/news/news/american-cancer-society-releases-new-breast-cancer-guidelines

Pace, L. & Keating, N. (2014). A Systematic Assessment of Benefits and Risks to Guide Breast Cancer Screening Decisions. *Journal of the American Medical Association 311*(13), 1327-1335. doi: 10.1001/jama.2014.1398.

Parise, C.A. & Caggiano, V. (2013). Disparities in race/ethnicity and socioeconomic status: Risk of mortality of breast cancer patients in the California Cancer Registry, 2000-2010. *BMC Cancer*, 13: 449. doi: 10.1186/1471

Patient Protection and Affordable Care Act. (2010). 111 P.L.148. 124 Stat. 1025. 2010 Enacted HR. 3590.

Peipins, L., Miller, J., Richards, T., Bobo, J., Liu, T., White, M., & ... Ekwueme, D. (2012). Characteristics of US Counties with No Mammography Capacity. *Journal Of Community Health*, *37*(6), 1239-1248. doi:10.1007/s10900-012-9562-z

Plescia, M., & White, M., C. (2013). The national prevention strategy and breast cancer screening: Scientific evidence for public health action. *American Journal of Public Health*, *103*(9), 1545-1548. doi: 10.2105/AJPH.2013.301305.

Rains, S. (2007). Perceptions of Traditional Information Sources and Use of the World Wide Web to Seek Health Information: Findings from the Health Information National Trends Survey. *Journal of Health Communication,12:*667-680. doi: 10.1080/10810730701619992

Rauscher, G., H., Allgood, K., L., Whitman, S., & Conant, E. (2012). Disparities in screening mammography services by Race/Ethnicity and health insurance. *Journal of Women's Health (15409996)*, *21*(2), 154-160. doi: 10.1089/jwh.2010.2415.

Redmond, N., Baer, H., Clark, C., Lipsitz, S. & Hicks, L. (2010). Sources of Health Information Related to Preventive Health Behaviors in a National Study. *American Journal of Preventive Medicine, 38*(6): 620-627. doi: 10.1016/j.amepre.2010.03.001

Reuben, S.H., Milliken, E.L, & Paradis, L.J. (2011). *America's Demographic and Cultural Transformation: Implications for Cancer*. President's Cancer Panel Report. National Cancer Institute.

Richardson, L., Royalty, J., Howe, W., Helsel, W., Kammerer, W. and Benard, V. (2010) Timeliness of Breast Cancer Diagnosis and Initiation of Treatment in the National Breast and Cervical Cancer Early Detection Program, 1996-2005. *American Journal of Public Health 100*(9), 1769-1776. doi: 10.2105/AJPH.2009.160184.

Rimer, B. and Glanz, K. (eds.). U.S. Health and Human Services. (2005). *Theory at a glance: A guide for health promotion practice.*

Sabatino, S.A., Coates, R.J., Uhler, R.J., Breen, N., Tangka, F., & Shaw, K.M. (2008). Disparities in mammography use among US women aged 40-60 years, by race, ethnicity, income, and health insurance status, 1993-2005. *Medical Care*, *46*(7), 692-700.

Sapolsky, R. (2005). Sick of poverty. *Scientific American 293* (6), 92-98. doi: 10.1038/scientificamerican1205-92

Sarfaty, M., Wender, R., & Smith, R. (2011). Promoting Cancer Screening within the Patient Centered Medical Home. *Cancer: A Cancer Journal for Clinicians 61*, 397-408. doi: 10.3322/caac.20125

Sassi, F., Luft, H. S., & Guadagnoli, E. (2006). Reducing Racial/Ethnic disparities in female breast cancer: Screening rates and stage at diagnosis. *American Journal of Public Health, 96*(12), 2165-2172. doi: 10.2105/AJPH.2005.071761.

Schueler, K., Chu, P., & Smith-Bindman, R. (2008). Factors associated with mammography utilization: a systematic quantitative review of the literature. *Journal Of Women's Health (15409996)*, *17*(9), 1477-1498. doi:10.1089/jwh.2007.0603

Smedley BD, Stith AY, Nelson AR. Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care, Board on Health Sciences Policy, IOM. *Unequal Treatment: Confronting racial and ethnic disparities in health care.* Washington, DC. National Academy of Sciences, 2003.

Soerjomatoram,I., Louwman,M., Ribot,J., Roukema,J. & Coebergh,J.(2008). An Overview of Prognostic Factors for Long-term Survivors of Breast Cancer. *Breast Cancer Research and Treatment, 107*: 309-330. doi: 10.1007/s10549-007-9556-1

Smith,M., Hochhalter, A., Ahn, S., Wernicke, M., and Ory, M. (2011). Utilization of Screening Mammography Among Middle-Aged and Older Women. *Journal of Women's Health 20*(11)1619-1626. doi: 10.1089/jwh.20130.2168

U.S. Census Bureau (2014). Virginia Quick Facts. Retrieved from: www.quickfacts.census.gov/qfd/states/51000.html

U.S. Department of Health and Human Services. "Foundation Health Measures." Retrieved from: http://healthypeople.gov/2020/about/DisparitiesAbout.aspx.

U.S. Government Accountability Office. (2006). GAO Report 06-724 Report to Congressional Requesters. *Mammography: Current Nationwide Capacity is Adequate, But Access Problems May Exist in Certain Areas*..

U.S. Health and Human Services, Healthy People 2020. (2013). *Healthy People 2020 Framework.* Retrieved from http://healthypeople.gov/2020/Consortium/HP2020Framework.pdf

Virginia Department of Health. (2012). Comprehensive Cancer Prevention and Control Program Report. Retrieved from: www.vdh.gov.

Virginia Department of Health, (2013) *Every Woman's Life Fact Sheet*. Retrieved from http://www.vdh.virginia.gov

Virginia Department of Health. (2014). Breast cancer in Virginia. Retrieved from: http://www.vdh.virginia.gov/ofhs/prevention/cpc/documents/2013/pdf/Female_breast_cancer_facts_2012%20062912.pdf

Vital signs: Racial disparities in breast cancer severity - United States, 2005-2009.(2012). *MMWR: Morbidity & Mortality Weekly Report, 61*, 922-926.

Webb, M., Cady, B., Michaelson, J., Bush, D., Calvillo, K., Kopans, D., and Smith, B. (2013). A Failure Analysis of Invasive Breast Cancer. *Cancer* doi: 10.1002/cncr.28199

Werle, C. (2011).The Determinants of Preventive Health Behavior: Literature Review and Research Perspectives. Working paper series RMT (WPS 11-15) 14 p. 2011.

Wheeler, S., Reeder-Hayes, K. and Carey, L. (2013). Disparities in breast cancer treatment and outcomes: Biological, social and health system determinants and opportunities for research. *The Oncologist*, 18: 986-993. doi 10.1634.

Wright, R. (1995). Logistic Regression, In Grimm.&Yarnold (Eds.), *Reading and Understanding Multivariate Statistics* (pp 217-244). Washington, D.C.: American Psychological Association.

Young,R., Schwartz, K., & Booza,J. (2011). Medical barriers to mammography screening of African American women in a high cancer mortality area: Implications for cancer educators and health providers. *Journal of Cancer Education*, *26*, 262-269. doi 10.1007/s13187-010-0184-9.

APPENDICES

APPENDIX A

VIRGINIA COMMONWEALTH UNIVERSITY

VCU

Make it real.

Office of Research
Office of Research Subjects Protection
BioTechnology Research Park
800 East Leigh Stree, Suite 3000
P.O. Box 980568
Richmond, Virginia 23298-0568

(804) 828-0868
Fax: (804) 827-1448

TO: Joann Richardson
CC: Melanie Dempsey
FROM: VCU IRB Panel B
RE: Joann Richardson ; IRB HM20004147 Factors that Influence Breast Cancer Diagnoses among Virginia Women 40-64 Years Old Who Utilized the Every Woman's Life Program 1998-2012

On 6/17/2015 the referenced research study ***qualified for exemption*** according to 45 CFR 46.101(b), category 4.

The information found in the electronic version of this study's smart form and uploaded documents now represents the currently approved study, documents, and HIPAA pathway (if applicable). You may access this information by clicking the Study Number above.

If you have any questions, please contact the Office of Research Subjects Protection (ORSP) or the IRB reviewer(s) assigned to this study.

Appendix B

COMMONWEALTH *of* VIRGINIA

Marissa J. Levine, MD, MPH, FAAFP
State Health Commissioner

Department of Health
P O BOX 2448
Richmond, VA 23218

TTY 7-1-1 OR
1-800-828-1120

July 9, 2015

Melanie Dempsey
Virginia Commonwealth University
701 West Grace Street
Box 843057
Richmond, Virginia 23284

Dear Ms. Dempsey:

Study #:	50186
Title of Study:	Factors that Influence Breast Cancer Diagnoses Among Virginia Women 40-64 Years old who utilized the Every Women's Life Program 1998-2012
Principal Investigator:	Melanie Dempsey
Type of Review:	Exemption

This letter is to advise you that the above referenced protocol has been reviewed by the Virginia Department of Health (VDH) Institutional Review Board (IRB) and has been approved.

Should the project undergo substantial changes (e.g., changes in the consent procedure, addition of potentially sensitive items to research instruments, changes in the treatment procedure) in the protocol or the subject population, another request for IRB review must be filed.

On behalf of the members of the VDH IRB, I wish you well on your research project. Please feel free to contact us if you have any questions or are in need of clarification.

Sincerely,

Dev Nair, PhD, MPH
Chair VDH IRB

VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

www.vdh.virginia.gov

Appendix C

Data Request Form

Requests for non-routine data, including any request for Division data sets, data matches or patient identifying information, must be submitted in writing to the Division of Prevention and Health Promotion for data release consideration. Clear explanation should be provided regarding proposed data needs. Submission of this request does not guarantee approval and/or release of Division of Disease Prevention data.

Submission Date: 05/26/2015

Requestor: Melanie Dempsey   Phone: 804-874-3409

Title: Doctoral student   Fax: 804-828-5778

Organization: VCU School of Education   E-mail: mcdempsey@vcu.edu

Purpose of Request:

The purpose of the request is to fulfill the requirements of my doctoral dissertation entitled "FACTORS THAT INFLUENCE BREAST CANCER DIAGNOSES IN VIRGINIA WOMEN 40-64 YEARS OLD WHO UTLIZED THE *EVERY WOMAN'S LIFE* PROGRAM 1998-2012. Specific research questions include:

1. Are there differences in socio-demographic characteristics (race, age, insurance, income, education, language, geographic location) between women diagnosed with breast cancer and those not diagnosed with breast cancer.
2. Are there differences in socio-demographic characteristics (race, age, insurance, income, education, language, geographic location) between women diagnosed with early stage (DCIS, Stage I, IA, IIB and IIIA) breast cancer and those not diagnosed with early stage breast cancer.
3. Are self-reported preventive health behaviors (prior mammogram and intention to stop smoking) related to early detection of breast cancer?
4. Are there differences in the participants' source of information (How did you hear about the EWL program?) as a function of race, geographic locale, language or education?

Data Requested: [include timeframe(s), disease (s), demographics, etc]:

Data requested from the Cancer Statistics and Tracking database include all Every Woman's Life participant in the breast cancer screening program from 1998-2012. The expected timeframe for use of the requested data is from June 2015-June 2016.

Data Use Methodology [if a research study/project, attach complete study design proposal]:

The proposed research will be secondary data analysis from the Every Woman's Life database, including all breast cycle participants (census) since VDH began housing the records in 1998 through 2012. Rationale for this timeframe stems from the periodic quality review of data and synchronization with the Virginia state cancer registry which was last performed in 2012.

A secondary analysis of the Every Woman's Life Cancer Statistics and Tracking (CaST) database will be conducted, with emphasis on questions dealing with demographics, diagnosis rates, source of information, primary language, and education. From an analysis of this data, descriptive statistics will be reported. Inferential statistics in the form of binary logistic regression will be performed to evaluate program outcomes. Longitudinal data analysis may illuminate important programmatic trends.

Given that enrollees must have an income at or less than 200% of the federal poverty level (FPL), socioeconomic status will be similar among all participants though levels of poverty may be established. Interest in differentiating factors among these low-income women drives this research interest. Analysis of the independent variables' (race, age, education, geographic locale, primary language, source of information) impact on the dichotomous dependent variable, diagnosis of breast cancer (Yes/No), is central to this investigation.

Description of Data Protection Mechanisms [staff accessibility, electronic security, locks, etc]:

Only the Primary Investigator, Joann Richardson, Ph.D. who serves as my dissertation chair and myself will have access to the data. The data will be maintained on a password protected thumbdrive and stored in a secure location. No files will be stored on a shared derived at anytime.

At the conclusion of this project, the data will be destroyed via electronic deletion of the files.

Melanie Dempsey — Melanie Dempsey 6/16/15

Printed Name of Requestor — Signature of Requestor/ Date

Joann T. Richardson — Joann Richardson 6/17/15

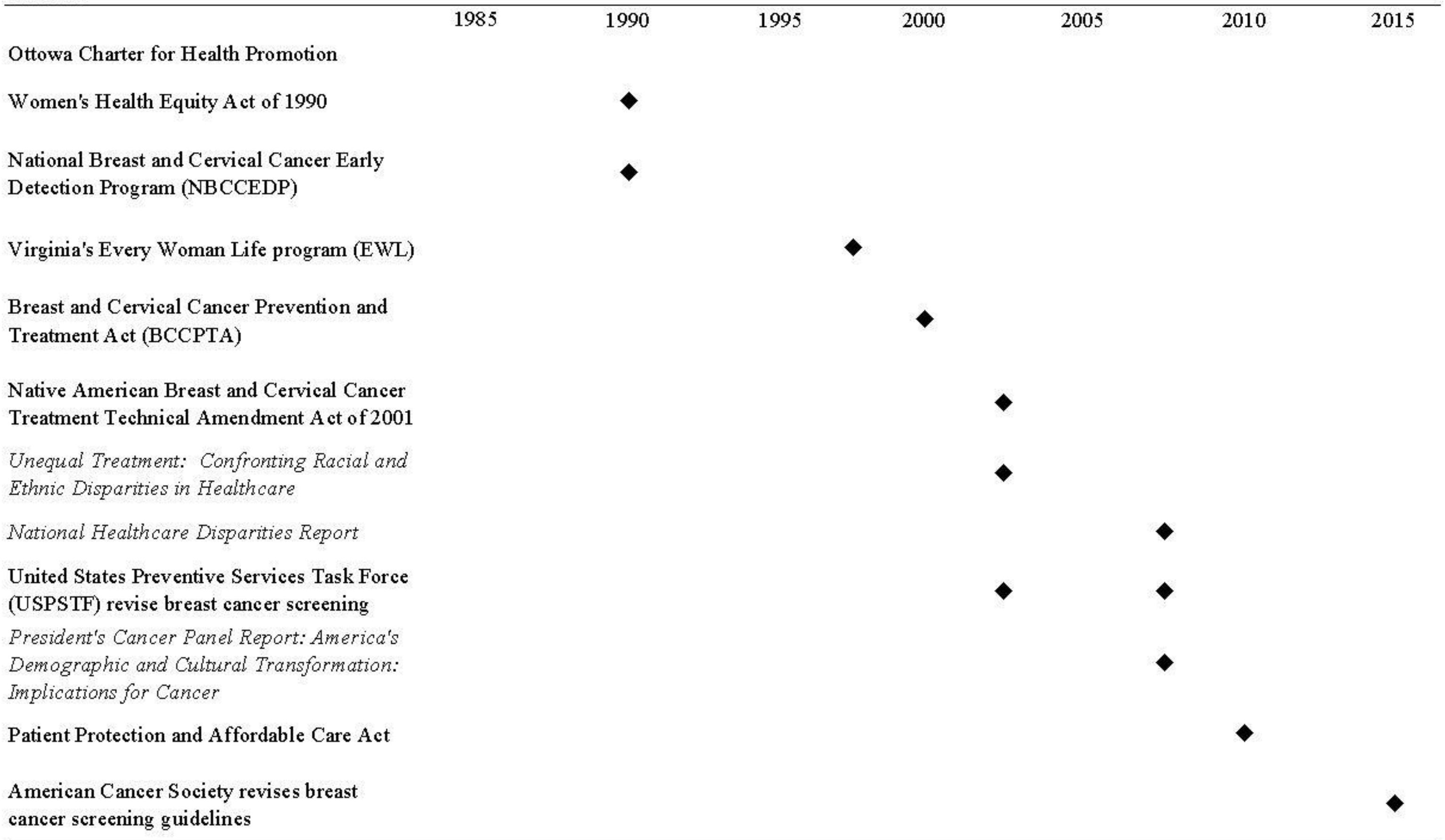
Printed Name of Dissertation Chair — Signature of Dissertation chair / Date

[illegible] — Vanessa Walker Harris 6-15-15

Printed Name of VDH Division Director — Signature of VDH Division Director / Date

Appendix D

Timeline



Appendix E

Every Woman's Life
A Virginia Department of Health Program

Client Eligibility Form

PERSONAL INFORMATION			
Last Name	First Name	MI	Maiden Name
SSN (or alien ID)	Birth Date / /	Age	
Address		City	
County	State / Zip	Home Phone ( ) -	
Work Phone ( ) -	Cell Phone ( ) -	Best Time to Call:	

1. What is your household income before taxes? $ /Year

2. How many people live on this income? (including yourself)

3. Do you have Medicaid? ☐ Yes ☐ No Medicare? ☐ Yes ☐ No → If YES ☐ Part A or ☐ Part B

4. Private insurance? ☐ Yes ☐ No → If YES, has deductible been met? ☐ Yes ☐ No

5. Do you now smoke cigarettes? ☐ Every day ☐ Some days ☐ Not at all ☐ Don't know ☐ Don't want to answer

6. Are you planning, thinking, or not thinking about quitting smoking in the next 30 days?
☐ Planning ☐ Thinking ☐ Not thinking ☐ Don't want to answer

7. What is the highest grade of school you completed? ☐ <9th ☐ Some high school ☐ High school graduate or equivalent ☐ Some college or higher ☐ Don't know ☐ Don't want to answer

8. Do you currently have any abnormal breast symptoms? ☐ Yes ☐ No

QUESTIONS FOR NEW EWL CLIENTS ONLY

9. How did you hear about the Every Woman's Life program? ☐ Brochure ☐ Community Health Worker ☐ Family/Friend ☐ Health Fair ☐ Internet/Web ☐ Radio/TV/Newspaper ☐ Other: ____________

10. Ethnicity: ☐ Hispanic ☐ Non Hispanic

11. Do you describe yourself as: (check ALL that apply) ☐ White ☐ Black/African American ☐ Asian ☐ American Indian/Alaskan Native ☐ Native Hawaiian/ Pacific Islander ☐ Other: ____________

12. What language do you speak every day? ____________

13. Have you ever had a pap test? ☐ Yes ☐ No
→ If YES, when was your last Pap test? (month/year) / or ☐ More than 5 years ago ☐ Don't know

14. Have you ever had a mammogram? ☐ Yes ☐ No
→ If YES, when was your last mammogram? (month/year) / or ☐ More than 5 years ago ☐ Don't know

PROVIDER SITE USE ONLY: Admin. Site: ____________ Case Manager: ____________
15. Enrollment Site: ____________ 16. Enrollment Date: ___/___/___
17. Client Status: Active – check one: ☐ New Patient ☐ Rescreen
18. ☐ Inactive due to: (list reason) ____________ 19. Effective Date ___/___/___
20. Detail: Previous Breast Cancer ☐ L Br ☐ R Br Hysterectomy for: Cervical Cancer ☐ Non Cancer ☐ Unknown ☐
21. ☐ Cervical record only, no breast form submitted ☐ Breast record only, no cervical form submitted
22. Client offered Virginia Quit Line information? ☐ Yes ☐ No Client offered other tobacco resources? ☐ Yes ☐ No

***Note: For questions 1 through 21, please refer to the Client Eligibility Form Instruction Sheet for guidance and additional information.

Appendix F

APPENDIX A: PRIMARY LANGUAGE CODE LIST

INDO-EUROPEAN (601-678)

English-based Pidgin Creoles (601-606)

601 Jamaican Creole
602 Krio
603 Hawaiian Pidgin
604 Pidgin
605 Gullah
606 Saramacca

Germanic languages (607-618)

607 German
608 Pennsylvania Dutch
609 Yiddish
610 Dutch
611 Afrikaans
612 Frisian
613 Luxembourgian

Scandinavian (614-618)

614 Swedish
615 Danish
616 Norwegian
617 Icelandic
618 Faroese

Romance languages (619-632)

619 Italian

French and French Creoles (620-624)

620 French
621 Provencal
622 Patois
623 French Creole
624 Cajun

Spanish and Spanish Creoles (625, 627, 628)

625 Spanish
626 Catalonian
627 Ladino
628 Pachuco

Portuguese and Portuguese Creoles (629-630)

629 Portuguese
630 Papia Mentae

631 Romanian
632 Rhaeto-romanic

Celtic languages (633-636)

633 Welsh
634 Breton
635 Irish Gaelic
636 Scottic Gaelic

637 Greek
638 Albanian

Slavic languages (638-652)

639 Russian
640 Bielorussian
641 Ukrainian
642 Czech
643 Kashubian
644 Lusatian
645 Polish
646 Slovak
647 Bulgarian
648 Macedonian
649 Serbocroatian
650 Croatian
651 Serbian
652 Slovene

Baltic languages (653-654)

653 Lithuanian
654 Lettish

655 Armenian

Iranian languages (656-661)

656 Persian
657 Pashto
658 Kurdish
659 Balochi
660 Tadzhik
661 Ossete

Indic languages (662-678)

662 India n.e.c.
663 Hindi
664 Bengali
665 Panjabi
666 Marathi
667 Gujarathi
668 Bihari
669 Rajasthani
670 Oriya
671 Urdu
672 Assamese
673 Kashmiri
674 Nepali
675 Sindhi
676 Pakistan n.e.c.
677 Sinhalese
678 Romany

679 Finnish (OTHER)
680 Estonian (OTHER)
681 Lapp (OTHER)
682 Hungarian (OTHER)
683 Other Uralic Lang. (OTHER)

ASIAN AND PACIFIC ISLAND LANGUAGES (684-695, 698-771)

Asian languages (684-695, 698-729)

Turkic languages (684-693)

684 Chuvash
685 Karakalpak
686 Kazakh
687 Kirghiz
688 Karachay

Appendix G

Federal Poverty Guidelines for the 48 Contiguous States and the District of Columbia

1998

Persons in Family/Household	100% FPL	150% FPL	200% FPL
1	$8,050	$12,075	$16,100
2	$10,850	$16,275	$21,700
3	$13,650	$20,475	$27,300
4	$16,450	$24,675	$32,900
5	$19,250	$28,875	$38,500
6	$22,050	$33,075	$44,100
7	$24,850	$37,275	$49,700
8	$27,650	$41,475	$55,300
For families/households with more than 8, add $2800 for each additional person			

1999

Persons in Family/Household	100% FPL	150% FPL	200% FPL
1	$8,240	$12,360	$16,480
2	$11,060	$16,590	$22,120
3	$13,880	$20,820	$27,760
4	$16,700	$25,050	$33,400
5	$19,520	$29,280	$39,040
6	$22,340	$33,510	$44,680
7	$25,160	$37,740	$50,320
8	$27,980	$41,970	$55,960
For families/households with more than 8, add $2820 for each additional person			

2000

Persons in Family/Household	100% FPL	150% FPL	200% FPL
1	$8,350	$12,525	$16,700
2	$11,250	$16,875	$22,500
3	$15,250	$22,875	$30,500
4	$17,050	$25,575	$34,100
5	$19,950	$29,925	$39,900
6	$22,850	$34,275	$45,700
7	$25,750	$38,625	$51,500
8	$28,650	$42,975	$57,300
For families/households with more than 8, add $2900 for each additional person			

2001

Persons in Family/Household	100% FPL	150% FPL	200% FPL
1	$8,590	$12,885	$17,180
2	$11,610	$17,415	$23,220
3	$15,630	$23,445	$31,260
4	$17,650	$26,475	$35,300
5	$20,670	$31,005	$41,340
6	$23,690	$35,535	$47,380
7	$26,710	$40,065	$53,420
8	$29,730	$44,595	$59,460
For families/households with more than 8, add $3020 for each additional person			

Appendix H

	Health District	Counties/City
1	Alexandria	Alexandria
2	Alleghany	Alleghany, Botetourt, Clifton Forge, Covington, Craig, Roanoke County, Salem
3	Arlington	Arlington
4	Central Shenandoah	Augusta, Bath, Buena Vista, Harrisonburg, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro
5	Central Virginia	Amherst, Appomattox, Bedford, Campbell, Lynchburg
6	Chesapeake	Chesapeake
7	Chesterfield	Chesterfield, Colonial Heights, Powhatan
8	Chickahominy	Charles City, Goochland, Hanover, New Kent
9	Crater	Dinwiddie, Petersburg, Prince George, Surry
10	Cumberland Plateau	Buchanan, Dickenson, Russell, Tazewell
11	Eastern Shore	Accomack, Northampton
12	Fairfax	Fairfax City, Fairfax County, Falls Church
13	Hampton	Hampton
14	Henrico	Henrico
15	Lenowisco	Lee, Norton, Scott, Wise
16	Lord Fairfax	Frederick, Clarke, Page, Shenandoah, Warren, Winchester
17	Loudoun	Loudoun
18	Mount Rogers	Bland, Bristol, Carroll, Galax, Grayson, Smyth, Washington, Wythe
19	New River	Floyd, Giles, Montgomery, Pulaski, Radford
20	Norfolk	Norfolk
21	Peninsula	James City, Newport News, Poquoson City, Williamsburg, York
22	Piedmont	Amelia, Buckingham, Charlotte, Nottoway, Prince Edward
23	Pittsylvania-Danville	Danville, Pittsylvanica
24	Portsmouth	Portsmouth
25	Prince William	Manassas City, Prince William
26	Rappahannock	Caroline, Fredericksburg, King George, Spotsylvania, Stafford
27	Rappahannock Rapidan	Culpeper, Fauquier, Madison, Orange, Rappahannock
28	Richmond	Richmond City
29	Roanoke	Roanoke City
30	Southside	Brunswick, Halifax, Mecklenburg
31	Thomas Jefferson	Albemarle, Charlottesville, Fluvanna, Greene, Louisa, Nelson
32	Three Rivers	Essex, Gloucester, King & queen, King Willima, Mathews, Middlesex, Northumberland, Richmond, County, Westmoreland
33	Virginia Beach	Virginia Beach
34	West Piedmont	Franklin County, Henry, Martinsville, Patrick
35	Western Tidewater	Franklin City, Isle of Wight, Southampton, Suffolk

Source: Virginia Department of Health, 2014

Appendix I

Demographics by Region

	Central	Northwest	Northern	Southwest	Southeast
Race n=34,942					
White	50.4%	83.3%	39.0%	88.2%	32.7%
Black	41.7%	9.4%	17.2%	8.6%	61.8%
American Indian/Alaska Native	0.7%	0.5%	0.6%	0.3%	0.6%
Asian	1.8%	1.9%	28.9%	0.6%	1.5%
Pacific Islander/Native Hawaiian	0.0%	0.0%	0.1%	0.1%	0.0%
Other	5.4%	4.8%	14.2%	2.4%	3.4%
Age in years (Mean, SD)	52.75 (6.3)	53.04 (5.9)	52.66 (6.0)	53.06 (5.8)	52.84 (5.9)
Income n=32668					
200% FPL	2.5%	1.7%	2.5%	2.8%	1.8%
150% FPL	18.5%	14.5%	15.3%	16.8%	11.1%
100% FPL	78.9%	83.8%	82.2%	80.4%	87.1%
Education n=13,179					
<9th grade	8.0%	10.4%	16.6%	10.4%	4.3%
Some high school	13.8%	15.5%	16.3%	16.0%	14.2%
High school graduate	40.6%	45.4%	33.8%	44.3%	51.6%
Some college	32.8%	26.5%	29.1%	26.7%	28.3%
Unknown	4.8%	2.3%	4.1%	2.6%	1.6%
Language n=34885					
English	93.6%	89.1%	47.5%	98.4%	98.0%
Spanish	4.9%	6.9%	22.8%	1.1%	1.1%
Other/IndoEuropean	0.4%	1.7%	2.0%	0.3%	0.2%
Asian	0.8%	1.2%	25.8%	0.1%	0.4%
Other	0.4%	1.1%	1.9%	0.2%	0.2%

Appendix J

Every Woman's Life Program Provider Sites, 2015-2016
Virginia Department of Health

Northwest Region

Augusta Free Clinic 342 Mule Academy Road Fishersville, VA 22939 Languages: Any (Language Line)	**Service Area:** Cities of Buena Vista, Lexington, Staunton and Waynesboro. Augusta, Bath, Highland and Rockbridge Counties.	**Contact:** Sheri Bang (540) 332-5606
Harrisonburg Community Health Center 1380 Little Sorrell Drive, Suite 100 Harrisonburg, VA 22801 Language: Any (Language Line)	**Service Area:** City of Harrisonburg. Page, Rockingham and Shenandoah Counties.	**Contact:** Erin Frazire (540) 437-3815
Winchester Medical Center c/o Oncology Services 1870 Amherst Street Suite B Winchester, VA 22601		**Coordinator:** Carol Carroll (540) 667-7229
Free Medical Clinic of Shenandoah Valley	**Service Area**: City of Winchester. Clarke and Frederick Counties.	**Contact:** Mary Sturm (540) 536-1680 X71227
St. Lukes Community Clinic	City of Front Royal and Warren Counties.	Louise LaBarca (540) 636-4325
Shenandoah County Free Clinic & Shenandoah Dental Clinic Languages: Spanish	City of Woodstock. Shenandoah County	Peggy Davison (540) 459-1700

Northern Region

Capital Breast Care Center 650 Pennsylvania Ave., SE Suite 230 Washington, DC 20003 Languages: Any (Language Line)	**Service Area:** Cities of Alexandria and Fairfax. Arlington, Fairfax, Loudon and Prince William Counties.	**Contact:** Tesha Coleman (202) 784-2704
Prince William Health District 9301 Lee Avenue Manassas, VA 2011 Languages: Any (Language Line)	**Service Area:** Cities of Manassas and Manassas Park. Prince William County	**Contact:** Donna Burton (703) 792-7494
Rappahannock Area Health District 608 Jackson Street Fredericksburg, VA 22401 Languages: Any (Language Line)	**Service Area:** City of Fredericksburg. Caroline, King George, Spotsylvania, and Stafford Counties.	**Contact:** Alyce Finch 540-507-7417
Vietnamese Resettlement Association 6131 Willston Dr., Room 6 Falls Church, VA 22044 Languages: Chinese, Lao, French, Korean, Spanish, Thai, Vietnamese	**Service Area**: Cities of Alexandria, Falls Church, Fairfax, Fredericksburg, Manassas and Manassas Park. Counties of Arlington, Clark, Culpepper, Fauquier, King George, Fairfax, Loudoun, Prince William, Spotsylvania, Stafford and Warren.	**Contact:** Yen Truong (703) 532-3716

Central Region

Updated 07/01/15

Every Woman's Life Program Provider Sites, 2015-2016
Virginia Department of Health

Bon Secours Richmond Health System 4121 Cox Rd., Suite 110 Glen Allen, VA 23060 Languages: Any (CyraCom)	**Service Area:** Cities of Colonial Heights, Hopewell, Petersburg and Richmond. Amelia, Caroline, Chesterfield, Dinwiddie, Hanover, Henrico, King William, New Kent, Powhatan. **Will accept women from any geographic location**	**Contact:** (804) 359-WELL (9355) – Press #1 and ask for Every Woman's Life Program
Central Virginia Health District 116 Kabler Lane P.O. Box 160 Rustburg, VA 24588 Languages: Any (Language Line)	**Service Area:** Cities of Bedford and Lynchburg. Amherst, Appomattox, Bedford and Campbell Counties.	**Contact**: Rebecca Parker (434) 592-9550 x121
Chickahominy Health District 12312 Washington Highway Ashland, VA 23224 Languages: Any (Language Line)	**Service Area:** Counties of Charles City, Goochland, Hanover and New Kent	**Contact**: Michele Landry 804-365-4313 x4328
Halifax Regional Hospital 2240 Wilborn Avenue P.O.Box 1115 South Boston, VA 24592 Languages: Phone Translator Services	**Service Area:** Counties of Charlotte, Halifax, and Mecklenburg	**Contact:** Karen Anderson 434-517-3932
HCA Richmond Health System Henrico Doctor's Hospital 1602 Skipwith Road Richmond, Virginia 23229 Languages: Any (Language Line)	**Service Area:** Cities of Colonial Heights, Hopewell, Petersburg, Richmond, Charles City, Franklin, Fredericksburg, James. Amelia, Caroline, Chesterfield, Culpeper, Goochland, Hanover, Henrico, Louisa, Powhatan, Prince George, Spotsylvania, Brunswick, Buckingham, Charlotte, Cumberland, Dinwiddie, Essex, Fluvanna, Gloucester, Greensville, King and Queen, King George, King William, Lancaster, Lunenburg, Mecklenburg, Middlesex, New Kent, Northumberland, Nottoway, Prince Edward, Richmond, Stafford, Surry, Sussex, Westmoreland.	**Contact:** Carrie Schaeffer (804) 200-7020
Pittsylvania-Danville Health District 200 HG McGhee Drive Chatham, VA 24531 Languages: Any (Language Line)	**Service Area:** City of Danville. Pittsylvania County.	**Contact:** Lori Wells (434) 432-7232 x236
Southside Health District 434 Washington Street Boydton, VA 23917 Languages: Any (Language Line)	**Service Area:** City of South Boston. Brunswick, Halifax, Mecklenburg Counties.	**Contact:** Julia Gwaltney (434) 738-6545 x105
University of Virginia HSC P.O. Box 800334	**Service Area**: City of Charlottesville. Albemarle, Buckingham, Culpeper, Fluvanna, Greene,	**Contact:** Shannon Grady Phone: (434) 243-9782

Updated 07/01/15

Charlottesville, VA 22908 Languages: Interpreter Service (50+Languages)	Louisa, Madison, Nelson, Orange and Rappahannock Counties.	Alternate: (434) 243-6415 24 hour message Line: (434) 243-6415
West Piedmont Health District 295 Commonwealth Blvd. Martinsville, VA 24112 Languages: Any (Language Line)	**Service Area:** City of Martinsville. Franklin, Henry and Patrick Counties.	**Contact:** Tina Oakes (276) 638-2311 x136

Updated 07/01/15

Appendix K

RQ1 Breast cancer diagnosis (age categorical)

		Crude OR	95% C.I. Lower	95% C.I. Upper	Adjusted OR	95% C.I. Lower	95% C.I. Upper
Race							
	White						
	Black	1.064	0.939	1.206	0.816	0.633	1.052
	American Indian/ Alaska Native	0.978	0.432	2.215	0.592	0.080	4.379
	Asian	0.570	0.392	0.830	0.862	0.382	1.946
	Pacific Islander/ Native Hawaiian	3.891	0.888	17.052	5.339	1.117	25.530
	Unknown	0.658	0.473	0.916	1.021	0.551	1.893
Age							
	40-49yo	1.001	0.875	1.145	0.750	0.585	0.962
	50+						
Education							
	<9th grade						
	Some high school	1.123	0.712	1.771	1.099	0.665	1.814
	High school graduate or equivalent	1.092	0.731	1.630	1.092	0.696	1.714
	Some college or higher	1.344	0.893	2.024	1.212	0.765	1.919
	Unknown	1.899	1.042	3.459	1.746	0.918	3.324
Income							
	200% FPL	0.789	0.498	1.251	1.157	0.638	2.098
	150% FPL	1.095	0.927	1.294	0.922	0.689	1.235
	100% FPL						
Language							
	English						
	Spanish	0.432	0.292	0.639	0.314	0.139	0.711
	Other/IndoEuropean	1.238	0.633	2.419	1.920	0.716	5.147
	Asian/Pacific Islanders	0.327	0.189	0.568	0.343	0.107	1.104
	Other	1.519	0.775	2.979	1.099	0.308	3.922
Prior mammo							
	No						
	Yes	0.758	0.653	0.879	0.764	0.570	1.024
	Unknown	1.046	0.786	1.393	1.436	0.918	2.247

note: referent group italicized font

Appendix L

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	156.646	52	.000
	Block	156.646	52	.000
	Model	156.646	52	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	3135.399[a]	.013	.054

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	9.850	8	.276

Contingency Table for Hosmer and Lemeshow Test

		CaStatus_All = No cancer diagnosed		CaStatus_All = Cancer diagnosed		
		Observed	Expected	Observed	Expected	Total
Step 1	1	1192	1197.046	14	8.954	1206
	2	1192	1188.336	13	16.664	1205
	3	1188	1184.495	17	20.505	1205
	4	1174	1173.166	23	23.834	1197
	5	1183	1177.132	22	27.868	1205
	6	1174	1174.369	33	32.631	1207
	7	1171	1167.010	34	37.990	1205
	8	1147	1159.359	58	45.641	1205
	9	1144	1147.472	61	57.528	1205
	10	1112	1108.617	93	96.383	1205

Classification Table[a]

	Observed		Predicted		
			CaStatus_All		Percentage Correct
			No cancer diagnosed	Cancer diagnosed	
Step 1	CaStatus_All	No cancer diagnosed	11677	0	100.0
		Cancer diagnosed	368	0	.0
	Overall Percentage				96.9

a. The cut value is .500

Appendix M

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	HD_new_refFairfax			82.686	34	.000			
	HD_new_refFairfax(1)	-.756	.589	1.646	1	.199	.469	.148	1.490
	HD_new_refFairfax(2)	.490	.818	.359	1	.549	1.632	.329	8.106
	HD_new_refFairfax(3)	-.798	.441	3.270	1	.071	.450	.190	1.069
	HD_new_refFairfax(4)	.149	.454	.108	1	.743	1.161	.477	2.828
	HD_new_refFairfax(5)	-.641	.456	1.975	1	.160	.527	.216	1.288
	HD_new_refFairfax(6)	-.379	.529	.514	1	.474	.685	.243	1.930
	HD_new_refFairfax(7)	-.232	.591	.155	1	.694	.793	.249	2.523
	HD_new_refFairfax(8)	-.722	1.081	.446	1	.504	.486	.058	4.045
	HD_new_refFairfax(9)	-.997	.489	4.154	1	.042	.369	.141	.962
	HD_new_refFairfax(10)	-1.107	.507	4.759	1	.029	.331	.122	.894
	HD_new_refFairfax(11)	.216	.683	.100	1	.752	1.241	.325	4.739
	HD_new_refFairfax(12)	-.160	.470	.116	1	.734	.852	.339	2.143
	HD_new_refFairfax(13)	-.349	.486	.517	1	.472	.705	.272	1.828
	HD_new_refFairfax(14)	-2.230	.694	10.339	1	.001	.107	.028	.419
	HD_new_refFairfax(15)	-.797	.475	2.818	1	.093	.450	.178	1.143
	HD_new_refFairfax(16)	.271	1.064	.065	1	.799	1.312	.163	10.559
	HD_new_refFairfax(17)	-.938	.444	4.455	1	.035	.391	.164	.935
	HD_new_refFairfax(18)	-1.084	.590	3.380	1	.066	.338	.107	1.074
	HD_new_refFairfax(19)	-.475	.456	1.084	1	.298	.622	.254	1.520
	HD_new_refFairfax(20)	-.021	.434	.002	1	.962	.980	.418	2.293
	HD_new_refFairfax(21)	.484	.549	.776	1	.379	1.622	.553	4.757
	HD_new_refFairfax(22)	.150	.472	.101	1	.751	1.162	.461	2.930
	HD_new_refFairfax(23)	-.544	.539	1.018	1	.313	.580	.202	1.670
	HD_new_refFairfax(24)	-.591	.658	.809	1	.369	.554	.153	2.009
	HD_new_refFairfax(25)	-.664	.469	2.005	1	.157	.515	.205	1.291
	HD_new_refFairfax(26)	.100	.509	.039	1	.844	1.105	.407	3.001
	HD_new_refFairfax(27)	-.339	.476	.508	1	.476	.712	.280	1.810
	HD_new_refFairfax(28)	-.292	.436	.448	1	.503	.747	.318	1.755
	HD_new_refFairfax(29)	.201	.569	.125	1	.724	1.223	.401	3.734
	HD_new_refFairfax(30)	-.601	.484	1.543	1	.214	.548	.213	1.415

HD_new_refFairfax(31)	-.244	.510	.230	1	.632	.783	.288	2.128
HD_new_refFairfax(32)	.812	.446	3.307	1	.069	2.252	.939	5.402
HD_new_refFairfax(33)	.121	.465	.068	1	.794	1.129	.454	2.810
HD_new_refFairfax(34)	.087	.467	.035	1	.853	1.091	.437	2.722
Age	.049	.010	25.601	1	.000	1.050	1.030	1.070
FPL			1.040	2	.595			
FPL(1)	.218	.304	.512	1	.474	1.243	.685	2.258
FPL(2)	-.099	.149	.440	1	.507	.906	.676	1.213
PHB2_mammo			12.649	2	.002			
PHB2_mammo(1)	-.323	.150	4.599	1	.032	.724	.539	.973
PHB2_mammo(2)	.283	.230	1.525	1	.217	1.328	.847	2.082
Race			7.382	5	.194			
Race(1)	-.192	.130	2.170	1	.141	.826	.640	1.065
Race(2)	-.511	1.022	.251	1	.617	.600	.081	4.441
Race(3)	-.171	.415	.170	1	.680	.843	.373	1.902
Race(4)	1.681	.801	4.398	1	.036	5.369	1.116	25.831
Race(5)	.050	.316	.025	1	.874	1.051	.566	1.952
Language			13.151	4	.011			
Language(1)	-1.125	.420	7.189	1	.007	.325	.143	.739
Language(2)	.620	.502	1.526	1	.217	1.858	.695	4.966
Language(3)	-1.045	.598	3.052	1	.081	.352	.109	1.136
Language(4)	.104	.648	.026	1	.872	1.110	.312	3.950
Education			3.841	4	.428			
Education(1)	.129	.256	.255	1	.613	1.138	.689	1.881
Education(2)	.114	.230	.244	1	.621	1.120	.714	1.759
Education(3)	.217	.235	.855	1	.355	1.243	.784	1.969
Education(4)	.564	.329	2.942	1	.086	1.757	.923	3.347
Constant	-5.387	.687	61.571	1	.000	.005		

a. Variable(s) entered on step 1: HD_new_refFairfax, Age, FPL, PHB2_mammo, Race, Language, Education.

Appendix N

Enrollment Site	#sample	#not reported	% not reported
Alexandria Neighborhood Health Services	207	94	45.4%
Alleghany Highlands Free Clinic	137	50	36.5%
Augusta Regional Clinic	437	3	0.7%
Beach Health Clinic (Virginia Beach)	115	115	100.0%
Bon Secours Richmond	1836	954	52.0%
Capital Breast Care Center	276	99	35.9%
Carillon Health System	2902	1820	62.7%
Central Piedmont (Danville)	260	259	99.6%
Central Regional (Chesterfield)	303	303	100.0%
Central Virginia HD	818	570	69.7%
Central Virginia Health System	32	0	0.0%
Charles City Med Group (Richmond City)	7	7	100.0%
Chesapeake Care Free Clinic	764	488	63.9%
Chesapeake City HD	1110	735	66.2%
Chesterfield HD	239	237	99.2%
Chickahominy HD	1	0	0.0%
Crossover Healthcare Ministry	713	499	70.0%
Culpeper Free Clinic	57	57	100.0%
Cumberland Plateau HD	1622	986	60.8%
Eastern Shore	1144	568	49.7%
EVMS	3155	2150	68.1%
George Washington University	163	163	100.0%
Halifax Regional Hospital	18	0	0.0%
Hampton City Health District	1161	778	67.0%
Harrisonburg Community Health Center	8	1	12.5%
Harrisonburg Rockingham Free Clinic	13	0	0.0%
HCA Richmond Health System	86	2	2.3%
Lenowisco Health District	1549	987	63.7%
Lord Fairfax Health District	10	10	100.0%
Loudoun County HD	200	200	100.0%
MCV (Richmond)	156	156	100.0%
Mount Rogers Health District	2285	1287	56.3%
National Capital Council (NOVA)	285	285	100.0%
Northern Virginia Community College	9	9	100.0%
OB/GYN Physicians, Inc.	149	149	100.0%
Olde Towne Medical Center	222	222	100.0%
Pittsylvania-Danville HD	559	357	63.9%
Portsmouth Community Health Center	3	3	100.0%
Prince William Health District-Woodbridge	79	9	11.4%
Rappahannock Area HD	1214	733	60.4%
Riverside Health Center	1	0	0.0%
Riverside Health System	2244	1495	66.6%
Southeastern Virginia Health System	528	233	44.1%
Southside Health District	199	115	57.8%
St. Mary's Hospital	29	29	100.0%
UVA	2709	1933	71.4%
VaLiance Health	1357	963	71.0%
Vietnamese Resettlement Association	1386	716	51.7%
West Piedmont	583	369	63.3%
Western Tidewater Free Clinic	100	0	0.0%
Western Tidewater HD	92	86	93.5%
Winchester Medical Center	1410	871	61.8%
Totals	34942	22155	63.4%

Appendix O

		Education Level Reported	No Education Level Reported	
		n(% within total sample)	n(% within total sample)	Sig.
Age	n=34,942			<.001
	40	247 (0.7%)	418 (1.2%)	
	41	243 (0.7%)	408 (1.2%	
	42	263 (0.8%)	414 (1.2%)	
	43	284 (0.8%)	428 (1.2%)	
	44	332 (1.0%)	450 (1.3%)	
	45	399 (1.1%)	668 (1.9%)	
	46	450 (1.3%)	596 (1.7%)	
	47	475 (1.4%)	562 (1.7%)	
	48	511 (1.5%)	603 (1.7%)	
	49	607 (1.7%)	683 (2.0%)	
	50	1366 (3.9%)	1967 (5.6%)	
	51	1104 (3.2%)	1509 (4.3%)	
	52	913 (2.6%)	1354 (3.9%)	
	53	813 (2.3%)	1291 (3.7%)	
	54	717 (2.1%)	1226 (3.5%)	
	55	654 (1.9%)	1122 (3.2%)	
	56	579 (1.7%)	1051 (3.0%)	
	57	512 (1.5%)	1032 (3.0%)	
	58	494 (1.4%)	981 (2.8%)	
	59	431 (1.2%)	961 (2.8%)	
	60	364 (1.0%)	887 (2.5%)	
	61	327 (0.9%)	940 (2.7%)	
	62	297 (0.8%)	952 (2.7%)	
	63	227 (0.6%)	952 (2.7%)	
	64	181 (0.5%)	697 (2.0%)	
Health Districts	n=34,270			<.001
	Alexandria	86 (0.3%)	58 (0.2%)	
	Alleghany	213 (0.6%)	334 (1.0%)	
	Arlington	30 (0.1%)	129 (0.4%)	
	Central Shenandoah	856 (0.1%)	1040 (3.0%)	
	Central Virginia	299 (0.9%)	667 (1.9%)	
	Chesapeake	631 (1.8%)	1161 (3.4%)	

	Chesterfield	222 (0.6%)	589 (1.7%)	
	Chickahominy	132 (0.4%)	184 (0.5%)	
	Crater	40 (0.1%)	135 (0.4%)	
	Cumberland Plateau	652 (1.7%)	1050 (3.1%)	
	Eastern Shore	576 (1.7%)	569 (1.7%)	
	Fairfax	676 (2.0%)	1026 (3.0%)	
	Hampton	380 (1.1%)	831 (2.4%)	
	Henrico	331 (1.0%)	314 (0.9%)	
	Lenowisco	560 (1.6%)	974 (2.8%)	
	Lord Fairfax	565 (1.6%)	916 (2.7%)	
	Loudoun	34 (0.1%)	196 (0.6%)	
	Mount Rogers	988 (2.9%)	1288 (3.8%)	
	New River	265 (0.8%)	475 (1.4%)	
	Norfolk	689 (2.0%)	1321 (3.9%)	
	Peninsula	512 (1.5%)	1168 (3.4%)	
	Piedmont	92 (0.3%)	114 (0.3%)	
	Pittsylvania-Danville	217 (0.6%)	528 (1.5%)	
	Portsmouth	320 (0.9%)	650 (1.9%)	
	Prince William	202 (0.6%)	192 (0.6%)	
	Rappahannock	490 (1.4%)	865 (2.5%)	
	Rappahannock Rapidan	174 (0.5%)	377 (1.1%)	
	Richmond	364 (1.1%)	817 (2.4%)	
	Roanoke	364 (1.1%)	817 (2.4%)	
	Southside	103 (0.3%)	135 (0.4%)	
	Thomas Jefferson	445 (1.3%)	855 (2.5%)	
	Three Rivers	241 (0.7%)	496 (1.4%)	
	Virginia Beach	179 (0.5%)	381 (1.1%)	
	West Piedmont	240 (0.7%)	504 (1.5%)	
	Western Tidewater	292 (0.9%)	428 (1.2%)	

Appendix P

RQ1 Odds Ratio for those without education status (age categorical)

			95% C.I.			95% C.I.	
		Crude OR	Lower	Upper	Adjusted OR	Lower	Upper
Race							
	White						
	Black	1.055	0.907	1.228	0.978	0.809	1.183
	American Indian/ Alaska Native	0.830	0.305	2.254	0.739	0.233	2.346
	Asian/PI/NH	0.551	0.338	0.899	1.146	0.598	2.196
	Unknown	0.535	0.347	0.825	0.658	0.391	1.107
Age							
	40-49	1.205	1.025	1.417	1.241	1.041	1.479
	50+						
Income							
	200% FPL	0.565	0.266	1.200	0.619	0.291	1.317
	150% FPL	1.201	0.980	1.472	1.207	0.977	1.492
	100% FPL						
Language							
	English						
	Spanish	0.373	0.223	0.624	0.476	0.256	0.883
	Other/IndoEuropean	1.020	0.416	2.499	1.171	0.455	3.015
	Asian/Pacific Islanders	0.267	0.119	0.598	0.180	0.054	0.525
	Other	1.588	0.738	3.416	1.325	0.506	3.469
Prior mammo							
	No						
	Yes	0.754	0.633	0.898	0.741	0.612	0.897
	Unknown	0.760	0.509	1.135	0.721	0.463	1.123

note: referent group italicized font

Appendix Q

RQ1-Crude Odds Ratio

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	HD_new_refFairfax			60.850	34	.003			
	HD_new_refFairfax(1)	.882	.311	8.031	1	.005	2.415	1.312	4.444
	HD_new_refFairfax(2)	-.461	.741	.387	1	.534	.631	.148	2.694
	HD_new_refFairfax(3)	.390	.263	2.204	1	.138	1.477	.883	2.472
	HD_new_refFairfax(4)	.562	.280	4.037	1	.045	1.754	1.014	3.036
	HD_new_refFairfax(5)	.432	.255	2.862	1	.091	1.540	.934	2.540
	HD_new_refFairfax(6)	-.272	.366	.553	1	.457	.762	.372	1.560
	HD_new_refFairfax(7)	.300	.462	.422	1	.516	1.350	.546	3.337
	HD_new_refFairfax(8)	-17.513	3459.260	.000	1	.996	.000	.000	.
	HD_new_refFairfax(9)	.512	.257	3.981	1	.046	1.668	1.009	2.758
	HD_new_refFairfax(10)	.269	.314	.733	1	.392	1.308	.707	2.419
	HD_new_refFairfax(11)	.781	.627	1.555	1	.212	2.184	.640	7.457
	HD_new_refFairfax(12)	.472	.271	3.034	1	.082	1.604	.943	2.728
	HD_new_refFairfax(13)	.625	.340	3.376	1	.066	1.869	.959	3.640
	HD_new_refFairfax(14)	.206	.277	.554	1	.457	1.229	.714	2.113
	HD_new_refFairfax(15)	.074	.289	.066	1	.797	1.077	.611	1.900
	HD_new_refFairfax(16)	-.885	.739	1.434	1	.231	.413	.097	1.757
	HD_new_refFairfax(17)	-.013	.272	.002	1	.963	.987	.579	1.683
	HD_new_refFairfax(18)	.565	.305	3.429	1	.064	1.760	.968	3.202
	HD_new_refFairfax(19)	.345	.253	1.860	1	.173	1.412	.860	2.318
	HD_new_refFairfax(20)	.376	.257	2.135	1	.144	1.457	.879	2.413
	HD_new_refFairfax(21)	1.106	.419	6.971	1	.008	3.022	1.330	6.868
	HD_new_refFairfax(22)	.982	.271	13.147	1	.000	2.669	1.570	4.538
	HD_new_refFairfax(23)	.589	.280	4.432	1	.035	1.802	1.041	3.119
	HD_new_refFairfax(24)	-.453	.616	.541	1	.462	.636	.190	2.126
	HD_new_refFairfax(25)	-.161	.313	.267	1	.606	.851	.461	1.570
	HD_new_refFairfax(26)	.506	.332	2.321	1	.128	1.659	.865	3.182
	HD_new_refFairfax(27)	.351	.279	1.583	1	.208	1.421	.822	2.456
	HD_new_refFairfax(28)	.689	.257	7.202	1	.007	1.993	1.204	3.297

HD_new_refFairfax(29)	.201	.546	.135	1	.713	1.223	.419	3.568
HD_new_refFairfax(30)	.410	.273	2.254	1	.133	1.506	.882	2.572
HD_new_refFairfax(31)	.467	.309	2.276	1	.131	1.595	.870	2.925
HD_new_refFairfax(32)	.495	.332	2.222	1	.136	1.641	.856	3.147
HD_new_refFairfax(33)	.818	.283	8.354	1	.004	2.266	1.301	3.947
HD_new_refFairfax(34)	.374	.332	1.274	1	.259	1.454	.759	2.786
Constant	-3.690	.202	332.086	1	.000	.025		

a. Variable(s) entered on step 1: HD_new_refFairfax.

RQ1-Fully adjusted

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Age	-.008	.006	1.679	1	.195	.992	.980	1.004
	FPL			4.820	2	.090			
	FPL(1)	-.493	.386	1.633	1	.201	.611	.287	1.301
	FPL(2)	.185	.108	2.944	1	.086	1.204	.974	1.487
	PHB2_mammo			10.593	2	.005			
	PHB2_mammo(1)	-.316	.098	10.415	1	.001	.729	.602	.883
	PHB2_mammo(2)	-.336	.226	2.209	1	.137	.715	.459	1.113
	Language			16.531	4	.002			
	Language(1)	-.749	.316	5.634	1	.018	.473	.255	.878
	Language(2)	.153	.482	.101	1	.751	1.165	.453	2.999
	Language(3)	-1.785	.581	9.456	1	.002	.168	.054	.523
	Language(4)	.285	.491	.335	1	.562	1.329	.508	3.481
	HD_new_refFairfax			45.845	34	.084			
	HD_new_refFairfax(1)	.175	.362	.233	1	.629	1.191	.586	2.420
	HD_new_refFairfax(2)	-.436	.754	.335	1	.563	.646	.147	2.834
	HD_new_refFairfax(3)	-.165	.306	.291	1	.590	.848	.466	1.544
	HD_new_refFairfax(4)	-.089	.323	.076	1	.783	.915	.485	1.724
	HD_new_refFairfax(5)	-.197	.302	.423	1	.515	.821	.454	1.486
	HD_new_refFairfax(6)	-.812	.402	4.085	1	.043	.444	.202	.976
	HD_new_refFairfax(7)	-.433	.521	.693	1	.405	.648	.234	1.799

	HD_new_refFairfax(8)	-18.088	3629.400	.000	1	.996	.000	.000	.
	HD_new_refFairfax(9)	-.128	.304	.177	1	.674	.880	.485	1.597
	HD_new_refFairfax(10)	-.451	.366	1.522	1	.217	.637	.311	1.304
	HD_new_refFairfax(11)	.218	.761	.082	1	.775	1.243	.280	5.525
	HD_new_refFairfax(12)	-.073	.314	.054	1	.816	.930	.502	1.722
	HD_new_refFairfax(13)	.013	.395	.001	1	.975	1.013	.467	2.198
	HD_new_refFairfax(14)	-.496	.325	2.321	1	.128	.609	.322	1.153
	HD_new_refFairfax(15)	-.597	.337	3.144	1	.076	.550	.284	1.065
	HD_new_refFairfax(16)	-1.218	.748	2.654	1	.103	.296	.068	1.281
	HD_new_refFairfax(17)	-.649	.320	4.101	1	.043	.523	.279	.979
	HD_new_refFairfax(18)	-.243	.367	.440	1	.507	.784	.382	1.609
	HD_new_refFairfax(19)	-.262	.301	.757	1	.384	.770	.427	1.388
	HD_new_refFairfax(20)	-.235	.303	.602	1	.438	.790	.436	1.432
	HD_new_refFairfax(21)	.509	.447	1.294	1	.255	1.663	.692	3.996
	HD_new_refFairfax(22)	.288	.319	.814	1	.367	1.334	.713	2.494
	HD_new_refFairfax(23)	-.193	.337	.330	1	.566	.824	.426	1.594
	HD_new_refFairfax(24)	-.576	.626	.847	1	.357	.562	.165	1.917
	HD_new_refFairfax(25)	-.819	.361	5.129	1	.024	.441	.217	.896
	HD_new_refFairfax(26)	-.043	.366	.014	1	.906	.958	.467	1.962
	HD_new_refFairfax(27)	-.271	.325	.695	1	.404	.762	.403	1.443
	HD_new_refFairfax(28)	.049	.303	.027	1	.870	1.051	.580	1.905
	HD_new_refFairfax(29)	-.365	.569	.412	1	.521	.694	.228	2.116
	HD_new_refFairfax(30)	-.208	.314	.437	1	.509	.812	.439	1.504
	HD_new_refFairfax(31)	-.386	.372	1.074	1	.300	.680	.328	1.410
	HD_new_refFairfax(32)	-.147	.378	.151	1	.698	.863	.412	1.811
	HD_new_refFairfax(33)	.202	.328	.381	1	.537	1.224	.644	2.326
	HD_new_refFairfax(34)	-.129	.368	.122	1	.727	.879	.428	1.808
	Race_5levels			3.019	4	.555			
	Race_5levels(1)	-.025	.097	.068	1	.795	.975	.806	1.179
	Race_5levels(2)	-.312	.589	.280	1	.597	.732	.231	2.324
	Race_5levels(3)	.127	.332	.148	1	.701	1.136	.593	2.176
	Race_5levels(4)	-.418	.266	2.477	1	.116	.658	.391	1.108
	Constant	-2.376	.420	32.053	1	.000	.093		

a. Variable(s) entered on step 1: Age, FPL, PHB2_mammo, Language, HD_new_refFairfax, Race_5levels.

Appendix R

RQ2-Age continuous model

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	40.735	12	.000
	Block	40.735	12	.000
	Model	40.735	12	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1143.453[a]	.038	.056

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	2.436	8	.965

Contingency Table for Hosmer and Lemeshow Test

		EWLstage_binary = Stage 0		EWLstage_binary = Invasive		
		Observed	Expected	Observed	Expected	Total
Step 1	1	43	42.474	61	61.526	104
	2	35	35.269	69	68.731	104
	3	32	32.594	73	72.406	105
	4	31	28.456	73	75.544	104
	5	25	25.520	76	75.480	101
	6	24	25.061	81	79.939	105
	7	18	22.979	87	82.021	105
	8	22	20.840	83	84.160	105
	9	21	18.128	85	87.872	106
	10	13	12.679	98	98.321	111

Classification Table[a]

	Observed		Predicted: EWLstage_binary: Stage 0	Predicted: EWLstage_binary: Invasive	Predicted: Percentage Correct
Step 1	EWLstage_binary	Stage 0	8	256	3.0
		Invasive	4	782	99.5
	Overall Percentage				75.2

a. The cut value is .500

RQ2-Age categorical model

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	40.761	12	.000
	Block	40.761	12	.000
	Model	40.761	12	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1143.427[a]	.038	.056

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.757	8	.783

Contingency Table for Hosmer and Lemeshow Test

		EWLstage_binary = Stage 0		EWLstage_binary = Invasive		
		Observed	Expected	Observed	Expected	Total
Step 1	1	38	36.532	49	50.468	87
	2	33	36.118	72	68.882	105
	3	34	33.055	71	71.945	105
	4	32	28.737	71	74.263	103
	5	40	40.126	119	118.874	159
	6	11	14.213	50	46.787	61
	7	20	23.153	86	82.847	106
	8	18	20.141	83	80.859	101
	9	23	17.786	79	84.214	102
	10	15	14.137	106	106.863	121

Classification Table[a]

			Predicted		
			EWLstage_binary		Percentage Correct
	Observed		Stage 0	Invasive	
Step 1	EWLstage_binary	Stage 0	8	256	3.0
		Invasive	4	782	99.5
	Overall Percentage				75.2

a. The cut value is .500

Appendix S

RQ3-Health district output

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	FPL			26.845	2	.000			
	FPL(1)	.428	.091	22.104	1	.000	1.535	1.284	1.834
	FPL(2)	-.068	.036	3.481	1	.062	.935	.871	1.003
	Age	.007	.002	10.290	1	.001	1.007	1.003	1.011
	HD			1246.755	34	.000			
	HD(1)	1.548	.282	30.184	1	.000	4.701	2.706	8.165
	HD(2)	.503	.347	2.103	1	.147	1.654	.838	3.266
	HD(3)	1.446	.269	28.815	1	.000	4.248	2.505	7.203
	HD(4)	2.248	.274	67.462	1	.000	9.464	5.536	16.181
	HD(5)	2.410	.270	79.861	1	.000	11.130	6.561	18.881
	HD(6)	2.221	.276	64.879	1	.000	9.214	5.367	15.816
	HD(7)	2.494	.294	71.796	1	.000	12.109	6.801	21.560
	HD(8)	2.751	.326	71.337	1	.000	15.658	8.270	29.646
	HD(9)	2.073	.270	58.721	1	.000	7.947	4.677	13.504
	HD(10)	1.117	.273	16.723	1	.000	3.054	1.789	5.216
	HD(11)	.448	.275	2.653	1	.103	1.565	.913	2.682
	HD(12)	2.368	.272	75.547	1	.000	10.677	6.259	18.212
	HD(13)	2.486	.280	78.684	1	.000	12.015	6.937	20.810
	HD(14)	1.954	.271	51.962	1	.000	7.059	4.149	12.009
	HD(15)	2.335	.271	74.485	1	.000	10.331	6.079	17.558
	HD(16)	1.426	.303	22.089	1	.000	4.162	2.296	7.543
	HD(17)	2.540	.269	88.935	1	.000	12.678	7.478	21.494
	HD(18)	1.404	.279	25.257	1	.000	4.073	2.355	7.043
	HD(19)	1.879	.269	48.625	1	.000	6.548	3.861	11.104
	HD(20)	1.939	.270	51.658	1	.000	6.952	4.097	11.797
	HD(21)	1.895	.306	38.263	1	.000	6.654	3.650	12.131
	HD(22)	1.868	.276	45.750	1	.000	6.477	3.769	11.130

HD(23)	1.785	.275	42.218	1	.000	5.960	3.479	10.213
HD(24)	.795	.292	7.388	1	.007	2.214	1.248	3.926
HD(25)	1.918	.271	50.162	1	.000	6.807	4.004	11.574
HD(26)	2.538	.282	80.843	1	.000	12.658	7.279	22.013
HD(27)	2.235	.273	67.244	1	.000	9.347	5.478	15.946
HD(28)	1.883	.271	48.402	1	.000	6.573	3.867	11.172
HD(29)	1.418	.304	21.778	1	.000	4.129	2.276	7.491
HD(30)	2.095	.271	59.601	1	.000	8.125	4.774	13.831
HD(31)	1.322	.277	22.715	1	.000	3.749	2.177	6.456
HD(32)	1.411	.282	24.967	1	.000	4.099	2.357	7.128
HD(33)	1.483	.277	28.593	1	.000	4.407	2.559	7.591
HD(34)	1.646	.278	35.159	1	.000	5.185	3.009	8.932
Race			16.503	5	.006			
Race(1)	.111	.033	11.698	1	.001	1.118	1.049	1.191
Race(2)	-.251	.177	2.026	1	.155	.778	.550	1.099
Race(3)	-.123	.125	.956	1	.328	.885	.692	1.131
Race(4)	.237	.551	.184	1	.668	1.267	.430	3.731
Race(5)	.021	.076	.080	1	.777	1.022	.881	1.185
Language			18.313	4	.001			
Language(1)	.084	.082	1.046	1	.306	1.088	.926	1.277
Language(2)	.019	.176	.012	1	.913	1.019	.722	1.440
Language(3)	-.616	.163	14.209	1	.000	.540	.392	.744
Language(4)	.108	.200	.290	1	.590	1.114	.752	1.649
Constant	-2.302	.287	64.133	1	.000	.100		

a. Variable(s) entered on step 1: FPL, Age, HD, Race, Language.

Appendix T

RQ3 Age categorical model

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	FPL			26.066	2	.000			
	FPL(1)	.420	.091	21.302	1	.000	1.522	1.274	1.820
	FPL(2)	-.068	.036	3.507	1	.061	.934	.870	1.003
	HD			1246.532	34	.000			
	HD(1)	1.544	.282	30.042	1	.000	4.684	2.697	8.137
	HD(2)	.499	.347	2.070	1	.150	1.648	.834	3.253
	HD(3)	1.444	.269	28.696	1	.000	4.235	2.498	7.183
	HD(4)	2.250	.274	67.589	1	.000	9.487	5.549	16.221
	HD(5)	2.413	.270	80.050	1	.000	11.165	6.581	18.941
	HD(6)	2.219	.276	64.768	1	.000	9.198	5.358	15.791
	HD(7)	2.495	.294	71.821	1	.000	12.117	6.805	21.575
	HD(8)	2.749	.326	71.232	1	.000	15.631	8.255	29.598
	HD(9)	2.069	.271	58.471	1	.000	7.914	4.657	13.448
	HD(10)	1.116	.273	16.701	1	.000	3.053	1.787	5.213
	HD(11)	.447	.275	2.648	1	.104	1.564	.913	2.681
	HD(12)	2.361	.272	75.094	1	.000	10.605	6.217	18.090
	HD(13)	2.482	.280	78.398	1	.000	11.964	6.907	20.724
	HD(14)	1.958	.271	52.169	1	.000	7.088	4.166	12.059
	HD(15)	2.331	.271	74.207	1	.000	10.289	6.054	17.487
	HD(16)	1.427	.303	22.112	1	.000	4.165	2.298	7.550
	HD(17)	2.536	.269	88.637	1	.000	12.628	7.448	21.409
	HD(18)	1.401	.279	25.135	1	.000	4.060	2.347	7.020
	HD(19)	1.883	.270	48.798	1	.000	6.571	3.875	11.145
	HD(20)	1.937	.270	51.559	1	.000	6.941	4.090	11.778
	HD(21)	1.905	.306	38.634	1	.000	6.718	3.684	12.248
	HD(22)	1.863	.276	45.478	1	.000	6.443	3.749	11.071
	HD(23)	1.786	.275	42.249	1	.000	5.966	3.482	10.222

	HD(24)	.795	.292	7.399	1	.007	2.215	1.249	3.928
	HD(25)	1.915	.271	50.010	1	.000	6.789	3.993	11.543
	HD(26)	2.544	.282	81.180	1	.000	12.730	7.319	22.138
	HD(27)	2.237	.273	67.335	1	.000	9.364	5.488	15.976
	HD(28)	1.879	.271	48.200	1	.000	6.549	3.852	11.132
	HD(29)	1.414	.304	21.634	1	.000	4.110	2.266	7.457
	HD(30)	2.105	.271	60.173	1	.000	8.211	4.823	13.977
	HD(31)	1.321	.277	22.683	1	.000	3.746	2.175	6.452
	HD(32)	1.412	.282	24.990	1	.000	4.102	2.359	7.134
	HD(33)	1.484	.277	28.616	1	.000	4.411	2.561	7.597
	HD(34)	1.645	.278	35.128	1	.000	5.182	3.008	8.928
	Race			16.239	5	.006			
	Race(1)	.110	.033	11.384	1	.001	1.116	1.047	1.190
	Race(2)	-.255	.177	2.084	1	.149	.775	.548	1.095
	Race(3)	-.122	.125	.948	1	.330	.885	.692	1.132
	Race(4)	.249	.551	.204	1	.651	1.283	.436	3.777
	Race(5)	.022	.076	.082	1	.774	1.022	.881	1.186
	Language			18.452	4	.001			
	Language(1)	.082	.082	1.005	1	.316	1.086	.924	1.275
	Language(2)	.022	.176	.016	1	.899	1.023	.724	1.445
	Language(3)	-.619	.163	14.338	1	.000	.539	.391	.742
	Language(4)	.110	.200	.303	1	.582	1.117	.754	1.653
	Age_binary(1)	-.137	.030	21.465	1	.000	.872	.823	.924
	Constant	-1.904	.265	51.675	1	.000	.149		

a. Variable(s) entered on step 1: FPL, HD, Race, Language, Age_binary.

Appendix U

RQ3 Age continuous model

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	2061.161	46	.000
	Block	2061.161	46	.000
	Model	2061.161	46	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	34840.544[a]	.074	.099

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	9.342	8	.314

Contingency Table for Hosmer and Lemeshow Test

		EWL_referral = Non-provider		EWL_referral = Provider		
		Observed	Expected	Observed	Expected	Total
Step 1	1	2118	2131.289	533	519.711	2651
	2	1736	1693.426	913	955.574	2649
	3	1532	1576.380	1126	1081.620	2658
	4	1367	1376.993	1281	1271.007	2648
	5	1349	1321.386	1302	1329.614	2651
	6	1280	1273.060	1371	1377.940	2651
	7	1209	1199.228	1458	1467.772	2667
	8	1051	1078.898	1623	1595.102	2674
	9	990	980.337	1641	1650.663	2631
	10	936	937.001	1810	1808.999	2746

Classification Table[a]

	Observed		Predicted		
			EWL_referral		Percentage Correct
			Non-provider	Provider	
Step 1	EWL_referral	Non-provider	7316	6252	53.9
		Provider	4364	8694	66.6
	Overall Percentage				60.1

a. The cut value is .500

RQ3 Age categorical model

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	2072.349	46	.000
	Block	2072.349	46	.000
	Model	2072.349	46	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	34829.355[a]	.075	.100

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.924	8	.864

Contingency Table for Hosmer and Lemeshow Test

		EWL_referral = Non-provider		EWL_referral = Provider		
		Observed	Expected	Observed	Expected	Total
Step 1	1	2126	2142.113	539	522.887	2665
	2	1706	1686.192	931	950.808	2637
	3	1547	1566.350	1094	1074.650	2641
	4	1341	1330.043	1199	1209.957	2540
	5	1310	1308.243	1309	1310.757	2619
	6	1319	1292.363	1376	1402.637	2695
	7	1206	1213.334	1485	1477.666	2691
	8	1114	1135.775	1701	1679.225	2815
	9	1001	995.785	1669	1674.215	2670
	10	898	897.802	1755	1755.198	2653

Classification Table[a]

			Predicted		
			EWL_referral		Percentage Correct
	Observed		Non-provider	Provider	
Step 1	EWL_referral	Non-provider	7344	6224	54.1
		Provider	4420	8638	66.2
	Overall Percentage				60.0

a. The cut value is .500

Appendix V

Health District	40-64 Age	2.0=100% FPL Income levels	1=Yes Prior Mammo	0=White Race	0=English Language	50+=1 Age group	2=HS grad Education
Alexandria	52.20	1.93	0.86	2.06	0.79	0.71	1.34
Alleghany	52.60	1.78	0.88	0.23	0.05	0.74	2.03
Arlington	53.50	1.84	0.81	1.89	1.42	0.81	1.50
Central Shenandoah	53.00	1.81	0.91	0.27	0.09	0.75	1.95
Central Virginia	52.10	1.80	0.88	0.47	0.03	0.68	2.00
Chesapeake	52.80	1.79	0.86	0.70	0.05	0.72	2.10
Chesterfield	53.20	1.79	0.85	1.18	0.30	0.77	2.02
Chickahominy	53.60	1.81	0.89	0.62	0.07	0.78	1.95
Crater	54.12	1.78	0.93	0.82	0.04	0.83	2.00
Cumberland Plateau	52.76	1.69	0.87	0.11	0.00	0.76	1.65
Eastern Shore	53.00	1.87	0.84	0.89	0.03	0.75	1.91
Fairfax	52.93	1.74	0.75	2.40	1.94	0.74	1.78
Hampton	53.17	1.82	0.89	0.92	0.06	0.82	2.28
Henrico	53.77	1.72	0.91	1.06	0.24	0.80	2.23
Lenowisco	52.22	1.77	0.90	0.12	0.01	0.67	1.79
Lord Fairfax	53.01	1.83	0.84	0.83	0.07	0.77	1.83
Loudoun	52.19	1.76	0.83	1.57	0.95	0.71	1.85
Mount Rogers	53.57	1.83	0.87	0.17	0.01	0.79	1.91
New River	53.69	1.78	0.93	0.23	0.02	0.81	2.02
Norfolk	51.73	1.90	0.87	0.92	0.02	0.66	2.00
Peninsula	53.45	1.86	0.88	0.88	0.04	0.78	2.04
Piedmont	52.39	1.73	0.90	0.52	0.02	0.64	1.96
Pittsylvania-Danville	52.39	1.86	0.94	0.68	0.01	0.83	1.94
Portsmouth	52.53	1.91	0.87	0.87	0.02	0.72	2.06
Prince William	51.13	1.81	0.79	2.15	1.14	0.65	1.88
Rappahannock	52.73	1.85	0.88	0.87	0.17	0.74	1.87
Rappahannock Rapidan	52.79	1.74	0.88	0.50	0.07	0.68	1.89
Richmond	53.12	1.80	0.89	1.23	0.15	0.75	2.13
Roanoke	53.36	1.80	0.89	0.59	0.08	0.79	2.15
Southside	54.24	1.75	0.94	0.86	0.01	0.84	1.87
Thomas Jefferson	51.38	1.67	0.93	0.55	0.05	0.59	2.02
Three Rivers	53.64	1.79	0.85	0.57	0.02	0.77	1.98
Virginia Beach	53.05	1.86	0.89	0.95	0.12	0.74	2.34
West Piedmont	52.57	1.83	0.99	0.47	0.03	0.71	2.03
Western Tidewater	53.46	1.86	0.89	0.74	0.03	0.78	2.01

Appendix W

EWL Enrollment Site	40-64 Age	2.0=100%FPL Income levels	1=Yes Prior Mammo	0=White Race	0=English Language	50+=1 Age group	2=HS grad Education
Alex. Neighborhood	51.37	1.89	0.82	1.96	0.78	0.60	1.38
Alleghany Highlands	52.47	1.80	0.85	0.18	0.00	0.72	1.94
Augusta Regional	50.59	1.75	0.97	0.22	0.03	0.61	2.02
Beach Health Clinic	55.10	1.97	0.96	1.35	0.28	0.93	NR
Bon Secours Richmond	53.87	1.83	0.90	0.94	0.13	0.82	2.17
Capital Breast Care Ctr	53.95	1.88	0.89	2.71	0.96	0.88	2.01
Carilion Health System	53.29	1.79	0.91	0.41	0.06	0.78	2.09
Central Piedmont	54.47	1.86	0.82	0.59	0.02	0.83	2.00
Central Regional	53.26	1.89	0.93	0.91	0.03	0.74	NR
Central Virginia HD	52.18	1.81	0.88	0.52	0.03	0.69	1.98
Central Va Health Svs	48.53	1.91	0.84	0.53	0.00	0.38	1.91
Charles City Med Group	48.14	1.86	0.57	1.86	0.43	0.43	NR
Chesapeake Free Clinic	53.13	1.82	0.83	0.71	0.08	0.75	2.02
Chesapeake City HD	52.54	1.77	0.88	0.70	0.04	0.70	2.19
Chesterfield Health Dept	53.02	1.82	0.81	0.71	0.23	0.78	1.50
Chickahominy HD	45.00	2.00	1.00	1.00	0.00	0.00	2.00
Crossover Ministry	53.24	1.82	0.85	1.65	0.37	0.75	1.69
Culpeper Free Clinic	55.46	1.81	0.93	0.44	0.09	0.91	NR
Cumberland Plateau HD	52.92	1.68	0.87	0.11	0.00	0.78	1.63
Eastern Shore	52.98	1.88	0.84	0.89	0.03	0.75	1.91
EVMS	52.03	1.90	0.87	0.91	0.02	0.68	2.02
Geo.Washington Univ.	54.85	1.79	0.72	2.17	1.45	0.88	NR
Halifax Regional Hosp.	52.22	1.78	1.17	0.67	0.00	0.72	1.89
Hampton City HD	53.17	1.82	0.90	0.93	0.05	0.82	2.27
Harrisonburg Comm.	51.75	1.50	0.75	0.63	0.50	0.75	1.86
Harrisonburg Rockingham	50.54	2.00	0.77	0.00	0.23	0.69	2.00
HCA Richmond	51.40	1.69	0.88	0.78	0.16	0.51	2.36
Lenowisco HD	52.12	1.77	0.90	0.11	0.01	0.66	1.80
Lord Fairfax HD	57.90	1.80	1.00	0.00	0.00	0.80	NR
Loudoun County HD	52.08	1.77	0.84	1.09	0.53	0.67	NR
MCV (Richmond)	51.63	1.86	0.88	0.82	0.10	0.63	NR
Mount Rogers HD	53.56	1.83	0.87	0.16	0.01	0.80	1.91
National Capital Council	52.73	1.82	0.80	1.79	1.30	0.72	NR
NOVA Community College	50.89	2.00	1.00	0.00	0.67	0.44	NR
OB/GYN Physicians, Inc.	53.95	1.85	0.83	0.80	0.02	0.79	NR
Olde Towne Medical Ctr	53.57	1.87	0.86	0.65	0.10	0.80	NR
Pittsylvania-Danville HD	53.66	1.86	0.99	0.70	0.02	0.84	1.95
Portsouth Comm. Health Ctr	47.00	2.00	1.00	0.67	0.00	0.33	1.67
Prince William HD-Woodbridge	46.23	1.87	0.70	1.70	0.72	0.29	2.13
Rappahannock Area HD	52.60	1.86	0.88	0.91	0.18	0.74	1.86
Riverside health Center	53.00	2.00	1.00	1.00	0.00	1.00	2.00
Riverside Health System	53.50	1.84	0.87	0.79	0.03	0.78	2.06
Southeastern Va Health System	53.28	1.85	0.89	0.86	0.04	0.79	2.16
Southside Health District	54.56	1.75	0.95	0.84	0.01	0.83	1.97
St. Mary's Hospital	51.97	1.79	0.83	0.00	0.00	0.79	NR
UVA	51.69	1.69	0.92	0.54	0.05	0.61	2.00
VaLiance Health	53.84	1.84	0.88	0.27	0.11	0.81	1.86
Vietnamese Resettlement	52.70	1.71	0.74	2.53	2.25	0.73	1.74
West Piedmont Health District	52.24	1.83	1.00	0.46	0.03	0.69	2.01
Western Tidewater Free	52.27	1.82	0.82	0.73	0.00	0.70	2.02
Western Tidewater HD	53.08	1.91	0.78	0.72	0.00	0.77	2.33
Winchester Medical Ctr	53.09	1.83	0.84	0.32	0.07	0.78	1.83

note: NR=none reported

VITA

Melanie Dempsey was born to Bliss and Nellie Croft in Kingston, Pennsylvania. She and her military family moved to Fort Bragg, North Carolina in 1963. Melanie graduated from South View High School in Hope Mills, NC. She received her Bachelor of Science degree from the University of North Carolina in Chapel Hill in 1984. Melanie continued at her education at UNC, receiving a post-baccalaureate certificate in Radiation Therapy Technology. It was the faculty in the Division of Radiologic Sciences and the Radiation Oncology Department that first inspired her to pursue her research interests. She joined the staff at the Harvard Joint Center for Radiation Therapy in Boston, Massachusetts. During her early career in radiation therapy, Melanie published "Filtration: The Answer to Automatic Exposure Response Problems in 140 kVp Chest Radiography with a 400 Speed Imaging System," "Film Dosimetry for Shaped Electron Fields," and "Stereotactic Radiosurgery for Arteriovenous Malformations." In 1987, Melanie moved to Richmond, Virginia to work and train as a medical dosimetrist at the Thomas N.P. Johns Radiation Oncology Center at Johnston-Willis Hospital.

Throughout the next 20 years, Melanie worked as a radiation therapist, medical dosimetrist, and manager in area cancer centers. She is proud to be co-founder of The Hawthorne Cancer Resource Center, a non-profit center located on the campus of CJW Medical Center. Melanie has provided countless in-services and workshops for staff, patients and support groups. She is an active member in her radiation oncology-related professional societies. This summer she was elevated to Fellow status in the American Association of Medical Dosimetrists at a ceremony in Orlando, Florida.

In 2006, Melanie joined the Department of Radiation Sciences at Virginia Commonwealth University as the Radiation Therapy Program Director. She received her Master's of Science degree in Education from Virginia Polytechnic and State University in 2008. She has been a co-author on multiple publications since arriving at VCU, including "Safety considerations for IMRT," "High Kilovotage Digital Exposure Techniques and Patient Dosimetry ," "Patient Safety Perceptions Among U.S. Radiation Therapists," "Perceptions of Clinical Education Preparedness at a Large US University: Is There a Difference Between US-born and Non-US born students?" and "The Effect of Vertical Off-Centering on Breast Dose During CT Simulation in Accelerated Partial Breast Irradiation Planning." In December 2015, Melanie received her doctorate in Education from Virginia Commonwealth University.